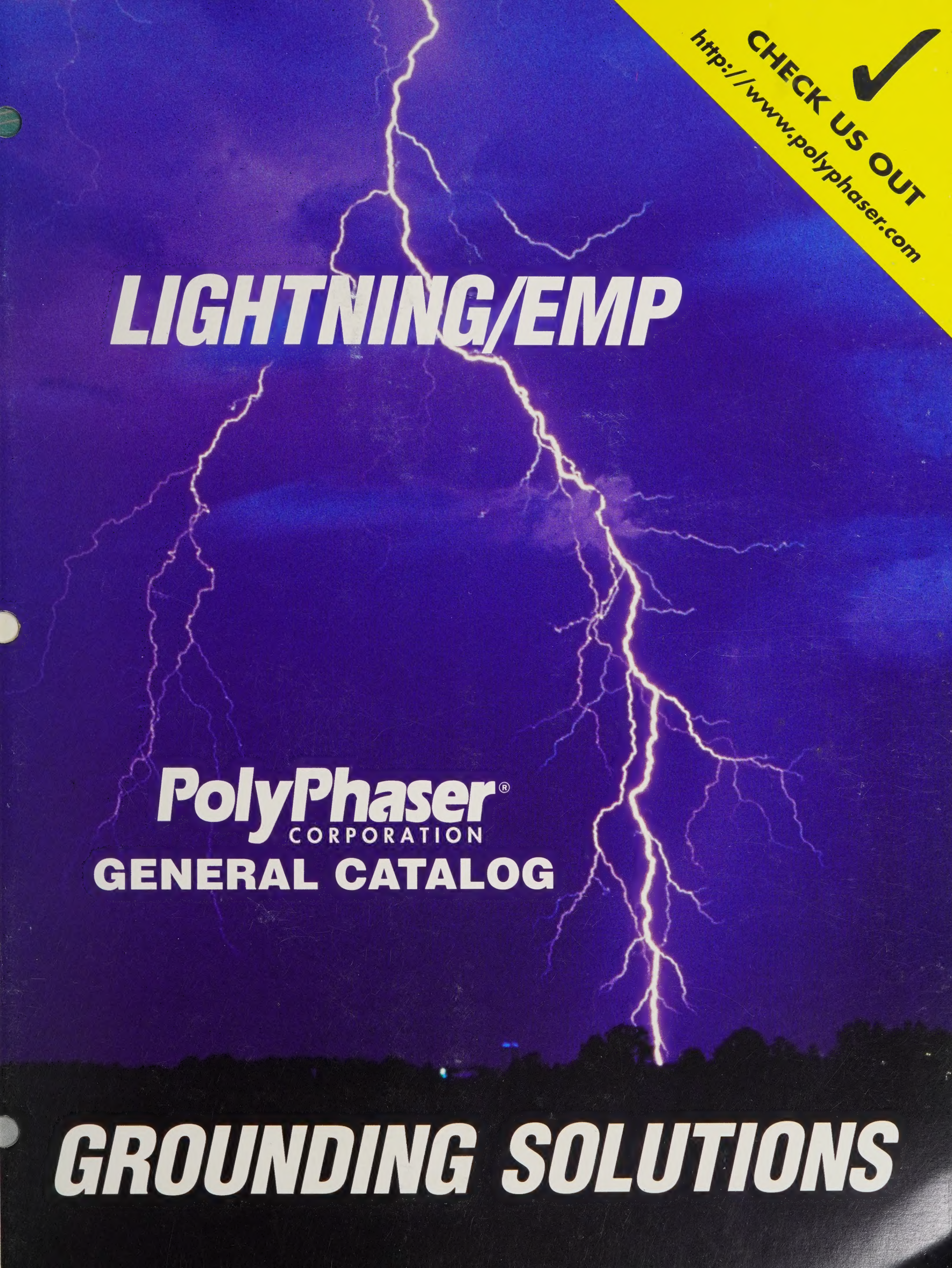

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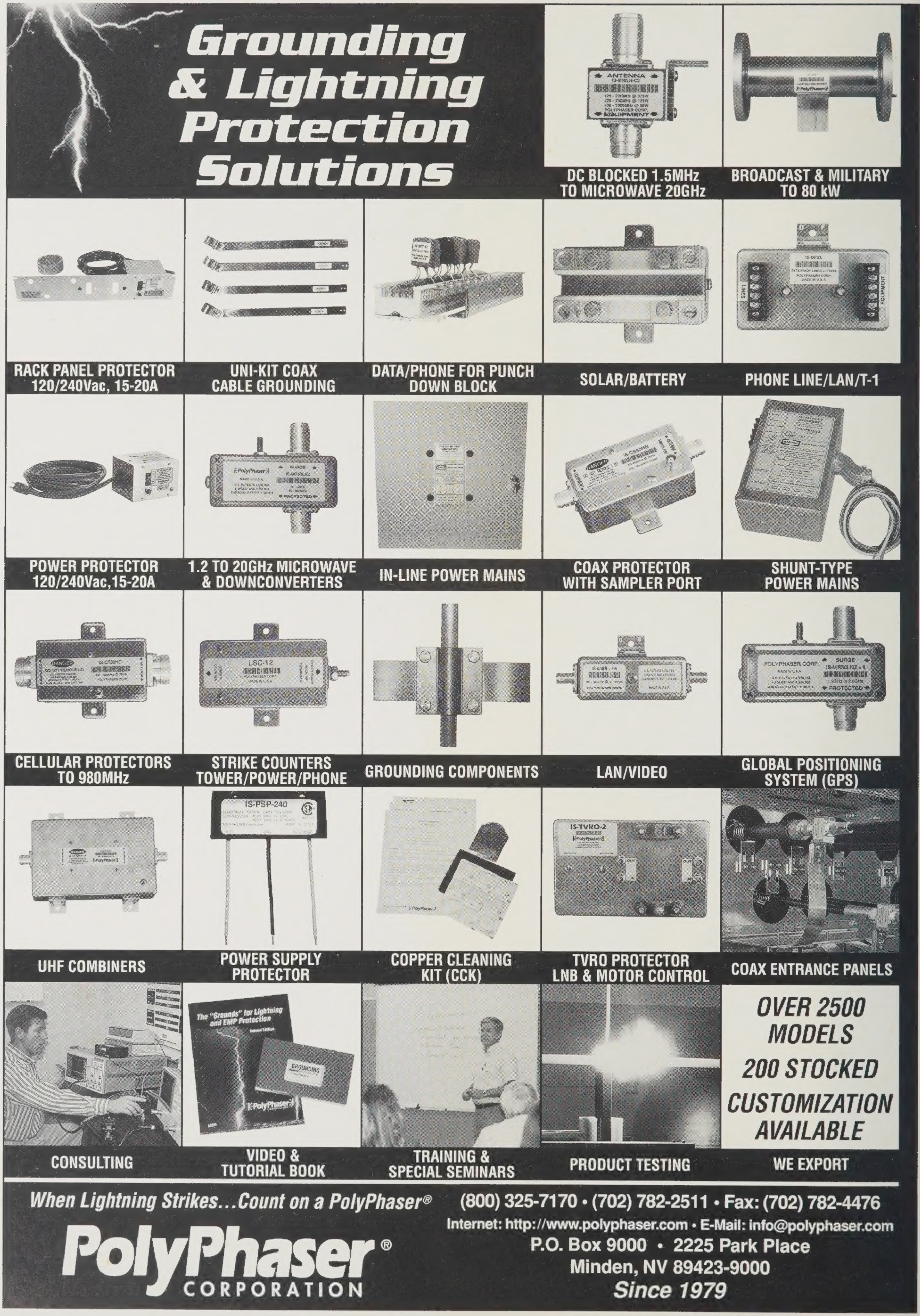
GROUNDING SOLUTIONS



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To receive your $50 discount off the Expo Package registration, please complete this entire form and include full payment. This offer is not valid when registering with other PCS '97 registration forms and may not be used with other PCS '97 registration options. Please photocopy form if additional badges are needed.

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- 01☐CEO, Chairman, President, Owner, Partner
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- 03☐Treasurer, CFO, Controller
- 11☐Manager, Director
- 04☐Business Development
- 05☐Sales, Marketing, Product Management
- 06☐Purchasing, Buyer
- 07☐Engineering, Technical, Service
- 08☐Public Relations, Communications
- 09☐Financial
- 12☐Writer, Editor
- 13☐Consultant
- 10☐Other ____________

Your Involvement In Purchasing
(check one)
- 50☐Directly Responsible
- 51☐Make Recommendations
- 52☐No Purchasing Involvement

Your Principal Business
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- Paging Software
- PCS (Narrow and Broadband)
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- SMR
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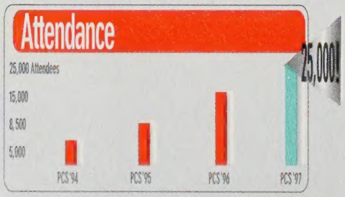

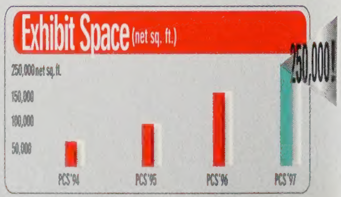

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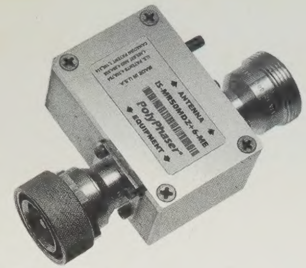

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Learn from lightning protection experts.

We will provide you with the latest information to assist you in developing and maintaining the best lightning protection. The course curriculum focuses on engineers and technicians.

It is a three-day program where you will learn the fundamentals of lightning, grounding applications, hands-on methods and solutions including a site evaluation at a nearby location. You will also receive a copy of "The Grounds for Lightning and EMP Protection" and the related video "Grounding an Overview" along with tutorial material.

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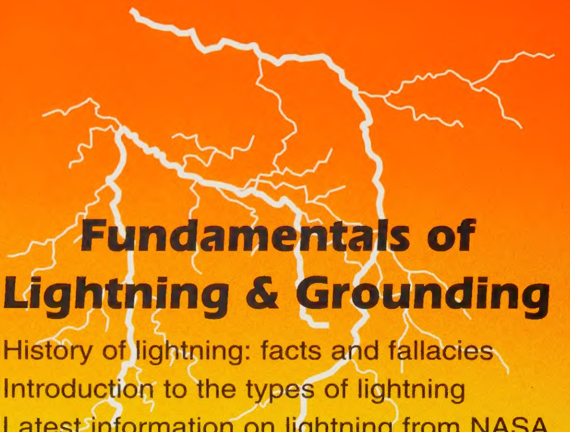

Fundamentals of Lightning & Grounding

☐History of lightning: facts and fallacies
☐Introduction to the types of lightning
☐Latest information on lightning from NASA
☐Distribution of lightning and how lightning information is gathered
☐Lightning protection and prevention
☐Risk assessment of being hit
☐Rolling ball theory and how to use it
☐Lightning strike power spectrum and what it means
☐LEMP and nearby lightning pulse energy coupling
☐Latent damage effects of lightning
☐Shielding requirements to reduce latent damage
☐The need for incoming telephone and power line protection
☐What protectors do and don't do
☐Types of protectors, components and their limitations
☐Threats to LANs, security cameras, lights, solar panels, generators and fuel tanks
☐Ground loops
☐Radio antennas
☐When a tower is hit
☐Fallacies about tower grounding
☐Ufer grounds and why you should use them
☐Coax and tower light protection needs
☐Grounding the coax lines
☐Why high rise buildings are like towers

Grounding Applications, Methods and Solutions

☐What a ground is and what it does
☐Review of inductors, capacitors and resistors in light of grounding
☐What is a good ground, ground saturation and the electron highway
☐Measure a ground system and problems with the measurements
☐How to increase soil conductivity
☐Electrolysis, corrosion and measuring soil pH
☐Grounding materials and the galvanic series
☐Cathodic protection and grounding
☐Mountaintop and sandy soil grounding
☐Connecting equipment to a ground system
☐Magnetic fields, sharp bends and strap conductors
☐Grounding inside the facility
☐Ground planes and raised floors
☐Single & multi-point grounding: Pros & Cons
☐Battery, generator and other site considerations

Hands-On Site Tour & Evaluation

☐Examples from various sites: The do's and don'ts
☐Working with grounding products: Hands-on
☐Site encounters: What you may find
☐Applying what you have learned: New and Existing sites

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☐ Please send a Carson Valley Inn discount registration card.

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Class Hours: The schedule is from 8:00a.m. to 4:00p.m. and lunch is provided.

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Tape Before Mailing

This is a photo of Big Bertha (PolyPhaser's lightning simulator) testing a whisker lightning brush with a 100kV, 62,000 ampere strike.

We Changed Blitz To

Designing of both 50 & 75 ohm coaxial protectors.

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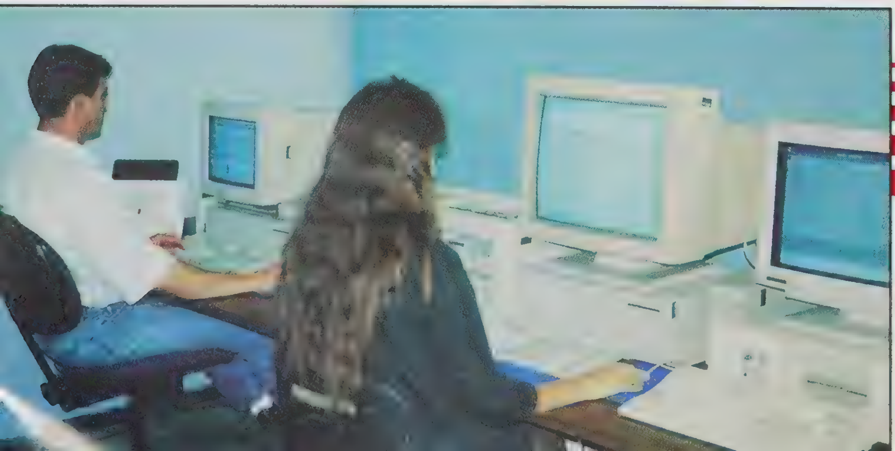
4 Gb/s scope and 20 GHz network analyzer for R&D.

Learning, Listening, Designing and Testing are words best describing PolyPhaser Corporation, a company founded from a market need and dedicated to lightning and grounding research. Founded in 1979 in Kissimmee, Florida, the company moved to Gardnerville, Nevada in 1984 and then to Minden in 1989. Lightning research is conducted in the mountains near Fountain Hills, Arizona where lightning storms are more plentiful. Triggered lightning, step leader RF spectrum analysis and mountain top grounding techniques are just a few of the current lightning research projects.

In Minden, Nevada, extensive destructive testing is performed on each newly developed PolyPhaser product with results measured on the latest 4 giga-sample, 1.1 gigahertz bandwidth digital oscilloscopes. Customer equipment and system testing are available on any of our three lightning simulators. Each has its own special attributes. Long duration pulses, very high currents to 200,000 amperes, and high energy surges are capable. The largest simulator consists of high density capacitors (3/4 ton) which can generate 100kV with 62kA and 100k Joules of energy in a traditional 8/20μs pulse. Customers can witness the tests or the tests can be video taped.



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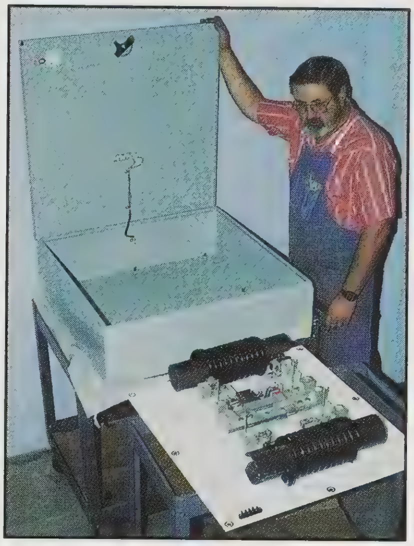
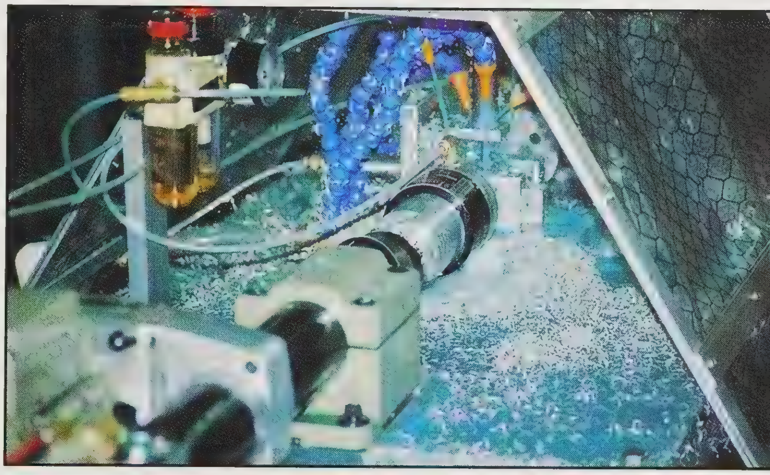
With our new building expansion to 53,000 square feet, a customer training center has been incorporated. This multimedia, hands-on style allows participants to learn proper lightning/EMP and grounding techniques. Local access to mountain top and valley sites provide realistic ground testing/site survey training.

RF protectors are CAD designed to 20GHz. High power RF testing with surge is conducted on each design to ensure proper protector operation under all conditions. The same attention to detail is provided to all the other protectors manufactured for power line and telephone/data lines.

New products are usually undertaken as a result of customer inquiry. Custom protectors are routinely designed, tested and produced as specials. Many of these become the future PolyPhaser catalog products of tomorrow.


Assembling large in-line power protector product.


Multiple multi-head automated drilling center.

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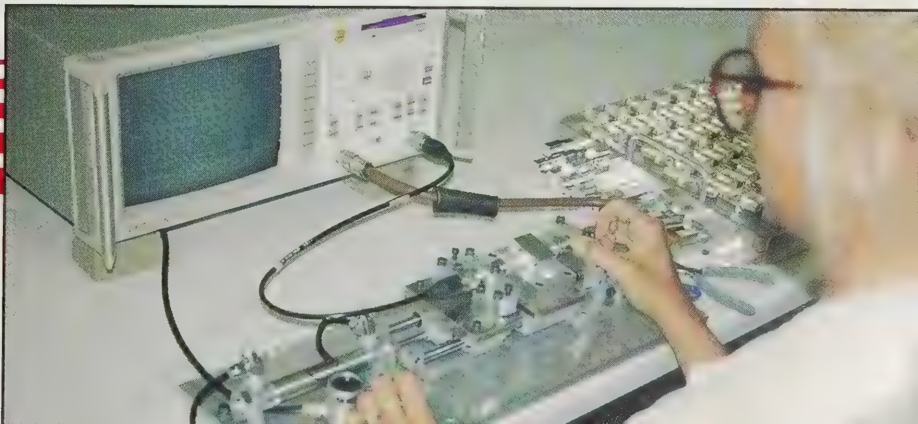
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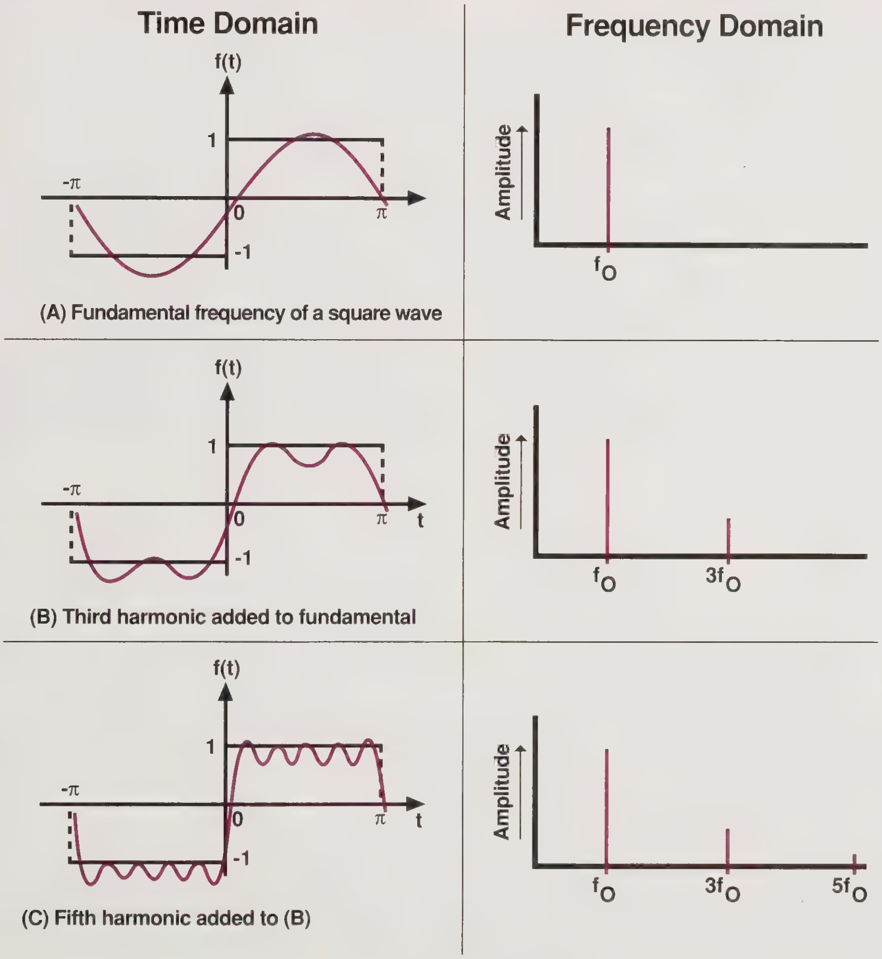
Time & Frequency in Protection Basics

There is a relationship between the level of protection from a surge voltage created by a strike and the frequency attenuation characteristics of the protector. Since the surge voltage on a coax line has a slower rate of rise than the lightning strike that created it, the frequencies present will also be lower. This relationship has a technical basis in math and engineering.

Looking at a square wave, it has both a fast risetime and decay time. If you took a square wave and made the ground level at the half way point, you could see that except for the sharp corners, a sine wave fits into the underneath area. This is the lowest frequency or fundamental of the square wave. To fill in the sharp corners, we can add small amounts of third and fifth harmonics of the fundamental sine wave.

As we continue to add higher odd harmonics and adjust the phase/amplitude of each, we can obtain a very good fit to the original square wave. This means that fast risetime waveforms are made of higher frequencies. The faster

—continued on page 2



(A) Fundamental frequency of a square wave

(B) Third harmonic added to fundamental

(C) Fifth harmonic added to (B)

By adding odd harmonics to the fundamental, the risetime is steepened. If the 7th and 9th harmonics are added to (C) in the correct phase and with decreasing levels, the results would be congruent with the original square wave.

Time & Frequency in Protection Basics

—continued from page 1

the risetime, the higher the frequencies needed to make it. This gives us a tool to use when we need to convert from the time domain into the frequency domain.

Since the surge on our coax is slower than the strike which made it, something had to happen to the higher frequencies. The answer is the center conductor attenuated the fast risetime components of the surge due to its inductance. We know that an inductor in series with a high frequency source will have an impedance which will "impede" or resist the flow of the signal through it. It develops a voltage drop much like a resistor does to dc current flow. This voltage drop can be calculated using many methods depending upon whether you wish to be in the frequency domain or the time domain.

In the time domain, the formula is easy for the upsloping surge since the instantaneous voltage drop is equal to the inductance times the changing current divided by the risetime ($E=L\ di/dt$). Unlike the resistive voltage drop, power is not lost. Inductors and capacitors do not lose energy (well, almost none), they merely store it briefly and then give it back. Since energy can neither be created nor destroyed, the energy in the coax line must be present no matter what. The fast risetime is momentarily stored and given back in the form of voltage over a longer period of time. This means that the higher frequencies have been changed to lower frequencies. The total energy of the strike is still present.

If we look at quarter wave stubs, the inductance of the stub at these low frequencies will be small, but not zero, at dc where most of the energy is found. Only with a dc blocked unit can one have infinite attenuation at dc. It stands to reason that dc blocked protectors are superior to any 1/4 wave device. (For more information on 1/4 wave to dc blocked protector comparison, please contact us.) As you look through our catalog, you will find the attenuation curves for each dc blocked device.

> *"This competitor missed the fact that 10kA must flow into your equipment before the gas tube fires!"*

If you now look at a dc continuity gas tube protector, the low frequencies will get through to your equipment. The higher frequencies which are necessary to fire the gas tube are not present. The input to most RF equipment is inductive. It has an inductor to ground across the input. This inductor is a protector of sort. It will not protect the equipment in the event of a lightning strike, but it is a level of protection. (See related article on built-in protectors, page 4.)

Since the higher frequencies are not present, the voltage built up across this input inductor is small. This means that the inductor will require more current to create enough voltage to reach turn-on for the gas tube. Another dc continuity RF gas tube protector manufacturer has calculated that 10kA would be required to be delivered to your equipment to get their gas tube to fire! Their calculations used the jumper cable's center conductor inductance to create the required $L\ di/dt$ voltage drop to turn on the tube. This competitor missed the fact that 10kA must flow into your equipment before the gas tube fires!

Considering the slowness of the surge's risetime on the center conductor of a coax, it would be too late by then. The damage would have already been done by the time the gas tube fires.

In dc blocked units, speed is a non-issue. This is because the internal capacitor simply gets charged during the upsloping surge. It stores the surge energy until the gas tube fires where it then discharges the stored energy through the tube. True, the storing current does go through your equipment (for a 270pF capacitor it reduces to a few amps for a few nanoseconds). This is presented in our catalog as the throughput energy.

To get a dc continuity type protector to work, you need both the coax jumper and the internal coil inductance values to be large. They are variables and only one is under your control. Thus, it is impossible to measure the throughput energy except when connected to a resistive load (or attenuator pad which is what other manufacturers do). ■

Do you know why steel ground rods are copper plated ??????

If you answered, to increase conductivity, you better read on. The base metal, steel, is more conductive than the best soil or even salt water. The real reason is for corrosion resistance. Copper, silver, mercury and gold have high resistance to corrosion, while those metals never found free in nature, like aluminum and magnesium, are easily corroded. In our February 1992 issue of *Striking News*, page 4, and duplicated in the second edition of *The "Grounds" for Lightning and EMP Protection*, page 18, we presented a galvanic table of metals. Noble metals like copper become the cathode when joined together with less noble metals in the presence of an electrolyte (water). Less noble metals become the sacrificial anode and corrode away.

Not listed in the galvanic table of metals is *Graphite*, since it is not a metal. Graphite is even more noble than silver and certainly much nobler than copper. Therefore, if a graphite backfill material is to be used as a ground enhancer to surround copper, the copper will be sacrificial to the graphite and will dissolve away into the underground.

> *"Copper will be sacrificial to the graphite and will dissolve away into the underground."*

The following affect the amount and speed of corrosion both above and below the soil:

1) *Water*. The presence of water mixed with contaminants is the basis of galvanic corrosion. Pure rain water is slightly acidic (pH 5.5 to 6.0). It picks up carbon dioxide as it falls which creates carbonic acid. It can start attacking some metals, even copper, without being in a junction. The ions etched from the copper go into solution in the rain water. As this rain water drips on galvanized tower sections, it will cause the zinc to combine and wash off. This leaves the bare steel to oxidize away.

2) *Oxygen*. This is the main corrosion accelerator. Rain water also picks up oxygen as it falls through the atmosphere. Water provides an excellent carrier of oxygen.

3) *Temperature*. Generally the higher the temperature the faster the chemical reaction.

4) *Texture of the metal(s)*. Glass smooth surfaces are less likely to corrode than rough finishes.

5) *Hydrogen Sulfide*. A gaseous product of exhaust emissions, it combines with rain water creating acid rain.

6) *Chlorine*. Tap water can have an acidic effect on underground materials.

7) *Inert gases*. Helium displaces oxygen and reduces the corrosive effect.

8) *Alkaline*. Although some alkalis tend to increase the rate of carbon dioxide absorption from the air which creates corrosive carbonate solutions, slight amounts of alkalinity can reduce corrosion rates.

9) *Salts*. Sodium chloride, found just about everywhere, increases the soil conductivity and also increases the corrosion process in nearly the same proportion to its concentration. Other naturally occurring salts or man added salts will do about the same. Only sodium carbonate or phosphate and potassium ferricyanide form a protective film that prevents further corrosion.

10) *Microorganisms*. Both bacteria and fungus can deteriorate metal. Some will give off acids in trapped water or when they die will decompose into acids.

Types of Corrosion

There are several types of corrosion. Listed below are the common names given for descriptive purposes:

1) *Uniform Etch:* A direct chemical attack from salts, urine and acids. If allowed to continue, a polished surface will dull and then take on a rough or frosted appearance.

2) *Pitting:* Tiny pin holes from localized chemical or galvanic attack.

3) *Intergranular:* Usually galvanic, this is a selective attack along the grain boundaries of an alloy metal. We have referenced this as "de-alloying." Typical corrosion-resistant alloys can break down when corrosion actually works on the individual components of the alloy.

4) *Exfoliation:* Found on extruded metals, the

—continued on page 6

BUILT-IN PROTECTION

You Can Trust

Since lightning has most of its energy at dc and low frequencies, it makes sense to have a protector that attenuates this region of the spectrum. This is why dc continuity protectors cannot provide the same level of protection as dc blocked units. When looking at the level of protection necessary for equipment, most equipment is sensitive to overvoltage stress. This stress can cause immediate damage or latent damage. Immediate damage is obvious, but latent damage represents the partial destruction of a component or semiconductor junction. Later, this weakened part will fail (probably on a blue sky day) and no correlation will be made to the lightning event that caused the damage.

Each piece of equipment has its own overvoltage tolerance level. Most equipment manufacturers have not tested for this level and thus do not know the statistical maximum for their products. Some manufacturers (and some dealers) engage in shortsighted thinking and believe that lightning strikes will create more sales of replacement equipment. Therefore, they perpetuate the myth that protecting the equipment will stifle orders. They couldn't be further from reality.

In this day of customer service, it is important to build quality into the equipment design. This has led a few manufacturers to some level of protection. This is a step in the right direction. But direct lightning protection can't be accomplished inside the equipment and the level of built-in protection can mislead the buyer into thinking the equipment is safe under all conditions. The best protection is a multi-level protector or cascaded multiple protectors. Each one will handle its portion of the threat.

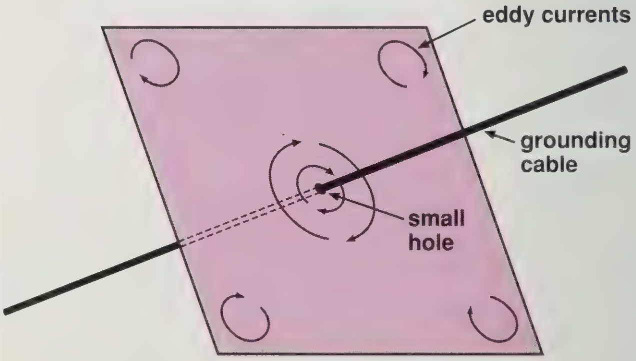
Direct strike protection should be "built in" to the installation, not into the equipment. Each equipment location has its own unique requirements. Some sites have good moist, highly conductive earth while others are on high desert mountains. This should signal the differences in installation and grounding requirements. Just as one site grounding technique can not cover all soil conditions, a single built-in protector should not be relied upon to handle all overvoltage conditions.

All input/outputs (I/Os) must be protected. We recommend these be protected at the entrance to the facility. For the new Personal Communications Services (PCS) and cellular cabinets, this would be at the interface/penetration panel. The most overlooked area is the sneak path. Some sneak paths are: cabinet to concrete (concrete is a conductor); other I/Os not protected; protectors not bonded together in a low inductance manner; coax lines with no center pin protection; tower lighting and non-single point grounding. When interconnecting to other cabinets, whether in a room or between outdoor cabinets, the grounding must be in common to a single point. This means all cabinets should be bonded to a central ground plate where the I/O protectors for the system should be located. If this is not done, the individual cabinet I/Os must be protected at each cabinet's single point ground plate. This means more protectors will be required and grounding techniques will be more complex.

Trying to do direct strike protection only at the cabinet level without an external single point protection plate allows the surge energy to reach the very electronics we are attempting to protect. From this location, surge energy can easily couple into the equipment where latent damage can occur. Since most cabinets are made of non-ferrous materials, the attenuation of the strike's low frequency magnetic field is non-existent. Every board trace will couple the magnetic field creating a voltage. The voltage level for a given dynamic magnetic field will depend on the capture area, orientation to the field, and impedance of the trace. Remember, the protectors and the grounding cable can radiate the magnetic field into your equipment.

Getting the ground conductor from the protector plate out through the metal cabinet or shelter to the earth can be counterproductive if not done right. The conduction of surge current means a magnetic field will

Eddy Current Formation



When penetrating a conductive plane, the metal intercepts some of the magnetic field and will set up eddy currents.

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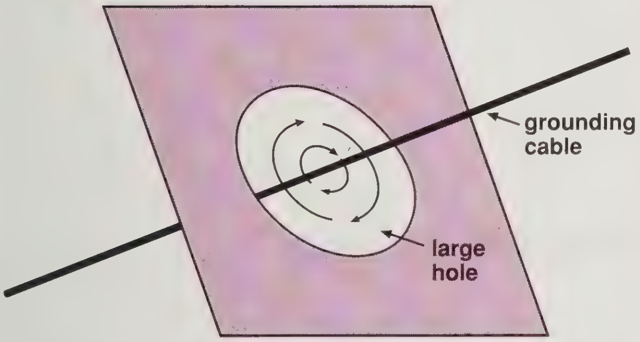
be created around the grounding conductor. When penetrating a conductive plane, the metal will intercept some of the magnetic field and set up eddy currents. When the event is over and the magnetic field subsides, the eddy current laden metal will re-induce a back current as the eddy fields collapse. (See diagrams.)

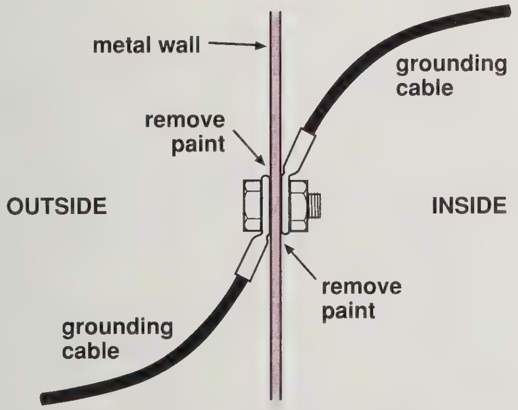
There are two methods to prevent the formations of eddy currents. The first method is to use an enlarged opening for the cable to exit. Typically, a hole size of 8 inches will have minimal eddies. The second way is to bond to the metal on each side and make it part of the path. Less of the magnetic field will be converted into eddy currents since the metal is now part of the circuit.

Relying only on protection built inside the equipment has its problems. Protection levels built in will be harder to diagnose let alone replace — if and when failure occurs. This is why it pays to have direct strike capability out where you can see and test it. Yes, test it. Maintain it. If you like a quarter wave stub because it has nothing to wear out, think again. There are no free lunches. This 50+ year-old technology is a compromise in protection level. The connector can also fail even if it is made by a "connector" manufacturer. This requires checking protectors and your grounding system once a year.

Methods to Prevent Eddy Current Formation



One method is to use an enlarged opening for the cable to exit. Typically, a hole size of 8 inches will have minimal eddies.



Bond cable to metal (each side) making it part of the path allowing less of the magnetic field to convert into eddy currents.

Recently, our cellular product was singled out as being the cause of an intermod at a site. This company removed our units from all their sites. The problem was not in our unit, but in the equipment connector which the OEM found and quietly replaced on all their equipment throughout the country. If the user had checked more thoroughly, they would have found the bad equipment connector. Yes, we still take the blame because this manufacturer is one of our customers. Now if any one says we generate intermod, we happily know it is being propagated by our competition. We have tested our product and found that one quarter wave stub had more intermod generation than our protector.

Once the entire equipment cabinet has been tested for its susceptibility to overvoltage stress, low frequency magnetic field damage and latent damage, the amount of protection both internally (board level) and I/O level can be designed and tested. (PolyPhaser excels at testing and can provide subsequent recommendations. No other protector manufacturer can provide this level of customer testing.) Only through testing and careful recommendations can an equipment manufacturer say they have gone the extra mile to protect their customers' investments.

Site losses at complex locations with equipment from many different manufacturers, may require a site visit to solve the problems. A PolyPhaser consultant is available to visit your site or we can provide a checklist for a customer produced video tape. Equipment is available for testing the site for PolyPhaser analysis and recommendations.

Equipment buyers should seek manufacturers who truly care about their customers. Choose manufacturers who have gone the extra mile and have subjected their equipment to actual lightning simulation testing. Whether PCS equipment, an antenna, or Global Positioning System (GPS) equipment, world class manufacturers are not afraid to use proper engineering and scientific techniques to cut their warranty costs and maintain customer satisfaction.

Next time you purchase equipment, ask if the manufacturer has tested the design for actual lightning conditions and has not just thrown in some untested system protectors. Some of the biggest manufacturers, in an attempt to be first and make their delivery deadlines, are using their customers to lightning test their equipment. Logic would dictate that you should only buy from a manufacturer who can show you the real test results. The number who can, can be counted on one hand. Proper design testing is like fine wine, it takes time to cover all the bases and do it properly. ■

Do you know why steel ground rods are copper plated?

— continued from page 3

corrosion occurs just below the metal surface and causes a blister to form. This appears where the extruding dies have forced the crystal structure of the metal to change direction.

5) *Galvanic:* The classic two dissimilar metal connection with a water electrolyte bridge is the most basic of corrosion problems.

6) *Concentration Cell:* As the amount of oxygen reaching the electrolyte varies, the rate of corrosion will vary accordingly. High concentrated areas of oxygen will have high levels of corrosion.

7) *Stress:* More corrosion will occur where high tensile stress is applied. This is where metal is bent or where rivets have been driven. Metals that have been cold worked (bent back and forth several times – copper is easily cold worked) should be annealed (stress relieved by heating). Stress corrosion appears as a crack running parallel to the metal grain.

8) *Fatigue:* Another form of stress corrosion where pits are defined along the grain. Additional stress begins to concentrate around them and cracking occurs at the bottom of the pits.

9) *Filiform:* Thread-like filament corrosion occurring under painted surfaces where water and oxygen have penetrated and form a corrosion concentration cell.

Helpful Hints

- Mother Nature will see that nothing we place in the soil will last forever. But we can do our part to design a grounding system that lasts.
- Use all similar metals in your grounding system. If copper is used, don't mix in tin plated copper wire.
- On mechanical compression joints, copper joint compound should be used to cover the hardware. This will prevent corrosion which can cause a loss of the compression strength and increase joint resistance over time. The joint compound, a petroleum based product with conductive copper flakes, displaces water, oxygen, acids and salts.
- Exothermic connections should be allowed to cool slowly to prevent stress corrosion.
- A grounding system should be tested annually.
- Grounding systems should also be checked annually for corrosion.
- Know your soil's pH. *(See March '95* ***Striking News****, page 2, discussing how to measure your soil's pH).* If acidic, either correct it to neutral or suffer the consequences.

In a future issue, we will look at Soil Salinity and Sodicity and the effect on corrosion and conductivity. ■

Congratulations to the classes of '95

The 1995 Lightning Protection Course was successfully completed by more than 100 individuals. Listed below by company affiliation are the graduates of the six seminars:

Alerton Technologies
Louia Weidman

Andrew Corporation
John Williamson
Pat Swider
Jonas Aleksa

Arizona Public Service
Edward Gouvier

Associated Systems
Churchill Miller
Joan Miller
Hal Bresson

Broadcast Communications
Jon Girard

Bedek Aviation Group
Richard Kline

Bell South
Jeff Tailor

Cartwright Communications
Dave Cannane

Cellnet Data Systems
Mark Riggs

City of Mesa
Dick Wiley

Comm-Omni
Joe Mersnik

Consultant
John Angehrn

Contel Cellular
Greg Thome

Crown Network Systems
Harold Harrington
Mike Racioppo

Cylix Corporation
Peter Norman

Deering Commuications
Brian Kedney

Dial Call
Steve Nipper
Mark Pruitt

Duley's Electric
Wayne Duley

Electronic Products
Dave Barquist
Jack Kline
Roger Diamond

Electro-Tek
Bill Frobose
Joe Stephens

Ericsson, Inc.
Buck Rogers

Ericsson Business Mobile Networks B. V.
Hans Valk

GPU Service Corporation
David Young

Horizon Comm Sales
Kent Douglas
Mike Melum
Ann Melum

Hyper-Tech
Shimon Barak

Kennedy Engineering
Ciaran Kennedy

KINI, L. C.
John Diederich

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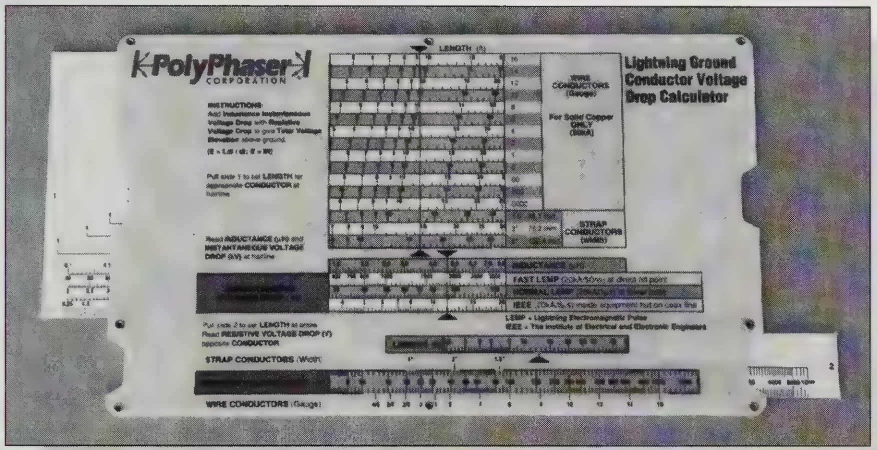
What's New at PolyPhaser

Lightning Ground Conductor Voltage Drop Calculator



PolyPhaser recently developed a slide chart to calculate the Lightning Ground Conductor Voltage Drop for copper strap and wire conductors.

Why is it important to calculate inductance and voltage drop?

Lightning is a fast event with a quick risetime and large amplitudes. The IEEE Standard represents a lightning waveform as an impulse having an 8μs rise time and a 20μs decay. Lightning, however, may have a 2μs risetime and to 45μs decay time. The average number of impulses (strokes) per lightning strike is three. Peak current will average 18kA for the first impulse and less (about half) for the second and third impulses.

An antenna support, tower and coaxial cables will develop a very large instantaneous peak voltage when subjected to the fast rise time impulses of a lightning strike. The peak voltage which develops as the result of a lightning strike is due to the larger inductive component of the system as described by $E = L\,di/dt$ and by the smaller resistive component, $E = IR$. Add the inductive and resistive component for a true peak voltage total. Calculating the ground path inductance is critical in determining the magnitude of the instantaneous peak voltage which will develop between the lightning protectors and the ground system.

PolyPhaser slide charts are now available for $5 from the factory (shipping and handling included). Call Customer Service at 1-800-325-7170 to place your order (check, money order, MasterCard, Discover or VISA accepted). ■

Graduates *—continued from page 6*

M G Telecomm
Mack Gilbert

MAC COM
Larry McNeely
Isabella McNeely

Manon Engineering
Dave Sokoloski
Smitty Smith

Maury Bettis Company
Jerry Lemberger
Marv Japel

Motorola
Gerald Smith
Berni Knepper
Mike Jones
Bruce Carpenter

Nebraska Cellular
Steve Tedmon
Scott Armes
Jeff Hughes

Nextel
Steve Schanck
Gary Heutmaker
John Tremblay
Mike Miller
Tom Smith
Scott DeBow
Eric Phelps

PEFCO
Mike French

PLC de Venezuela
Leonardo Rivas

Pacific Gas & Electric
Larry Bettencourt

Primus Electronics
Keith Rogers
Gerry Fritzke

Pulstar Distributing
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RF Industries
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Mark Mezzapica

RainBird Company
Rod McWhirter

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Royal Dutch Shell
Gary A. Twine

Santa Fe Distributing
Lee Eaton
Robert Elliott

Schenk Lightning Rod
Mike Schenk

Security Video, Indiana
Bob Reed

South Central Bell
A. C. Mann
Nathan Funderburke

Southern Company Services
Keith Wallace
Susan Williamson

Svare Forensic Electrical Engineering
Bob Svare

Talley Communications
David Little

Tower Inspection
Sparky Holder
Mike Byers

Trilogy Communications
Larry Lindner

Union Function Co., Ltd.
J. C. Lin

U. S. Air Force
Augusto Medina
Doug Gollott

U. S. Coast Guard
John Swidrak

U. S. Bureau of Reclamation
Arlen Hilton

University of California, San Diego
Damian Holland

W. R. Block & Associates
Ron Block
Mary Jane Block

3 Phi Power Quality
Jerry Lopez ■

Trade Shows & Seminars

PolyPhaser will participate in the following trade shows. Please stop by and visit with us. Three-day training programs are scheduled at PolyPhaser headquarters through 1996. Call 800-325-7170 to register.

- MEXCOM/LATCOM '96 - Mexico City
  January 24-26 - Booth 35
- ENTELEC - Dallas, TX
  March 18-20 - Booth 204
- CTIA/Wireless '96 - Dallas TX
  March 25-27 - Booth 721
- IWCE - Las Vegas, NV
  April 24-26 - Booth 335
- Dayton Hamvention - Dayton, OH
  May 17-19 - Booth 440, 441 & 442
- AFCEA/TechNet '96 - Washington, DC
  June 4-6 - Booth 4311 & 4313
- UTC - Kansas City, MO
  June 16-18 - Booth 217 & 219
- APCO (Int'l) - San Antonio, TX
  Aug. 11-15 - Booth 1110 & 1112
- ASIS - Atlanta, GA
  Sept. 9-12 - Booth 2427 & 2429
- **PolyPhaser Training:**
  The Lightning Protection Course
  February 20-22, 1996
  April 30 - May 2, 1996
  May 21-23, 1996
  September 17-19, 1996
  October 8-10, 1996
  October 29-31, 1996

In This Issue...

- ▶ Time & Frequency in Protection Basics
- ▶ Built-in Protection You Can Trust
- ▶ Steel Ground Rods & Copper Plating

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RESALE Price List

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PAGE	MODEL NUMBER	Column 1	Column 2
PART 1	***dc Type***		
6, 7	IS-50BB/(1.5,6,18), IS-50NB/(1.5,6,18), IS-50UB/(1.5,6,18)	$ 56.95	$ 48.50
6, 7	IS-50TB/(1.5,6,18), IS-75NB/(1.5,6,18)	67.95	58.00
6, 7	IS-75BB/(1.5,6,18), IS-75FB/(1.5,6,18), IS-75UB/(1.5,6,18)	67.95	58.00
6	IGA-90V	23.95	19.25
8	IS-158E	438.95	373.25
8	IS-318E	814.95	692.75
9	IS-TWAX	131.95	112.25
PART 2	***dc Blocked***		
11	IS-NEMP-C0, IS-NEMP-C1, IS-NEMP-C2	91.95	78.25
12, 13	IS-50UX-C0, IS-50UX-C1, IS-50NX-C0, IS-50NX-C1, IS-50NX-C2	56.95	48.50
12, 13	IS-75F-C1	49.95	41.75
14, 15	IS-B50LU-C0, IS-B50LU-C1, IS-B50LN-C0, IS-B50LN-C1, IS-B50LN-C2	59.95	51.00
14, 15	IS-B50HU-C0, IS-B50HU-C1, IS-B50HN-C0, IS-B50HN-C1, IS-B50HN-C2	64.95	55.25
16	IS-MR50LN, IS-ML50LN, IS-MH50LN, IS-MT50LN, IS-MU50LN	96.95	82.50
PART 3	***dc Blocked and Grounded***		
18	IS-GF50LN, IS-LR50LN	94.95	80.75
PART 4	***dc Injector/dc Path***		
19	IS-MR50LNZ+6, IS-MR50LNZ+15	96.95	82.50
20, 21	IS-DC50LN+(15,20,26,30,36), IS-GC50LN+(15,20,26,30,36),	94.95	80.75
20, 21	IS-DC50LNZ+(15,20,26,30,36),	94.95	80.75
22	IS-MD50LNZ	94.95	80.75
23	IS-SB75F	63.95	54.50
23	IS-DB75F	68.95	58.75
PART 5	***Combiner Protectors***		
24	IS-CU50HN, IS-VU50HN	151.95	129.25
25	IS-ST50HN(-B), IS-TT50HN(-B), IS-UT50HN(-B)	130.95	111.50
26, 27	IS-CS50HN(-B), IS-PS50HN(-B)	111.95	95.25
26, 27	IS-CS50HD(-B), IS-PS50HD(-B)	176.95	150.50
26, 27, 28	IS-CS50H78E, IS-CT50H78E	208.95	177.75
28	IS-CT50HN(-B), IS-PT50HN(-B)	111.95	95.25
28	IS-CT50HD(-B), IS-PT50HD(-B)	176.95	150.50
PART 6	***Special Applications - Satellite Dish***		
29	IS-TVRO-P, IS-TVRO-2	127.95	109.00
29	IS-TVRO-2P	132.95	113.25
29	IS-PLTVRO-P, IS-PLTVRO-2	248.95	211.75
29	IS-PLTVRO-2P	253.95	216.00
29	IS-AM36V	84.95	72.25
PART 7	***RF Coupled Shield/dc Blocked***		
30, 31	IS-IE50LU-C0, IS-IE50LU-C1, IS-IE50LN-C0, IS-IE50LN-C1, IS-IE50LN-C2	106.95	91.00
30, 31	IS-IE50HU-C0, IS-IE50HU-C1, IS-IE50HN-C0, IS-IE50HN-C1, IS-IE50HN-C2	112.95	96.25
30, 31	IS-IEML50LN, IS-IEMH50LN	161.95	137.75
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32, 33	IS-DPDDL, IS-CLDP, IS-DPXL, IS-DPHSD	149.95	127.50
32, 33	IS-6PDDL, IS-CL6P, IS-6PXL, IS-6PHSD	356.95	303.50
32, 33	IS-SPTL	57.95	49.50
32, 33	IS-DPTL	105.95	90.25
32, 33	IS-6PTL	255.95	217.75

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(415) 694-4972
FAX: (415) 694-1486

U. S. DISTRIBUTORS

W.R. Block & Associates, Inc.
327 Barbara Drive
Clarksboro, NJ 08020-1510
(609) 423-2255
(800) 421-7170
FAX: (609) 423-0891

Harger Lightning Protection, Inc.
301 Ziegler Dr.
Grayslake, IL 60030
(847) 548-8700
(800) 842-7437
FAX: (847) 548-8755

Technical Equipment Dist., Inc.
4280 Dow Rd., Ste 102/103
Melbourne, FL 32934
(407) 259-2711
(800) 729-8334
FAX: (407) 242-3109

Primus Electronics Corporation
18424 South I-55 West Frontage Rd.
Joliet, IL 60435-65555
(800) 892-1413 (IL only)
(800) 435-1636 (815) 436-8945
FAX: (800) 767-7605 (815) 436-8954

TESSCO
34 Loveton Circle
Sparks, MD 21152-5100
(410) 472-7000
(800) 472-7373
FAX: (410) 771-0694
Other offices in OH

Pulstar Distributing
3520 International Drive
St. Paul, MN 55110-5251
(612) 490-9053
(800) 634-4246
FAX: (612) 490-7934

Horizon Comm Sales
3409 Enterprise Dr. Ste C
Rowlett, TX 75088
(972) 475-1179
(800) 442-1734
FAX: (972) 475-1293

Electro-Comm
4950 Oakland St.
Denver, CO 80239
(303) 371-8182
(800) 525-0173
FAX: (800) 423-8018 or
FAX: (303) 371-8158

Talley Communications Corp.*
23125 Bernhardt St.
Hayward, CA 94545
(510) 783-2111 (All Others)
(800) 223-4949 (CA Only)
FAX: (510) 783-2118
Other offices in CA, AZ

Santa Fe Distributing, Inc.
9640 Legler Rd.
Lenexa, KS 66219
(913) 492-8288
(800) 255-6595
FAX: (913) 894-2136

Comm-Omni
200 Industrial Parkway #10
Chagrin Falls, OH 44022
(216) 247-7030
(800) 543-8790
FAX: (216) 247-6199

Alltel Supply, Inc.
6625 The Corners Pkwy, Ste. 400
Norcross, GA 30092
(770) 448-5210
(800) 533-3161
FAX: (770) 446-0420

Hutton Communications *
4112 Billy Mitchell Dr.
Dallas, TX 75244-2315
(972) 239-0580
(800) 442-3811
FAX: (972) 239-5264
Other offices in WA, GA, CO, IL

AF CommSupply, Inc.
11500 West 90th St.
Overland Park, KS 66214
(913) 492-6212
(800) 255-6222
FAX: (913) 492-2948

***Sprint* North Supply Company**
600 New Century Parkway
New Century, KS 66031-8000
(913) 791-7000
(800) 639-2288
FAX: (913) 791-7091

West Antenna Corporation
4110 Burlington Rd.
Greensboro, NC 17405-8629
(910) 621-2473
(910) 375-0235

*****NOTE:*** *Please contact this location for the phone number of their office nearest you or contact PolyPhaser Corporation for an inventory search and we can direct you to the nearest distributor or representative.*

When Lightning Strikes… Count on a PolyPhaser®

PolyPhaser Corporation

2225 Park Place
Minden, NV 89423-9000
(702) 782-2511 - FAX: (702) 782-4476

INTERNATIONAL DISTRIBUTORS

ARGENTINA

Datawaves S.R.L.
Thames 1368
1414 Buenos Aires
(54) 1 777-7707
FAX: (54) 1 777-1006

AUSTRALIA & NEW ZEALAND

RF Industries Pty., Ltd.
P.O. Box 4762
Unit B, 3 Lenton Place
North Rock, 2151
New South Wales
(612) 9 630-0655
FAX: (612) 9 630-0884

BRAZIL

SGM Telecom
Av. do Barro Branco 301
Jabaquara CEP-
04324-090 Sao Paulo SP
(55) 11 5588-1080
FAX: (55) 11 5588-2797

CANADA

Sinclair Technologies, Inc.
85 Mary St.
Aurora, Ontario L4G 6X5
(905) 727-0165
FAX: (905) 727-0861

Hutton Communications
24 The East Mall, Unit 12
Etobicoke (Toronto)
Ontario M8W 4W5
(416) 255-6063
FAX: (416) 255-9179

CHILE

PLC International S.A.
Seminario 790,
Piso 5 Oficina C
Nunoa, Santiago
(56) 2 225-3133*
(56) 2 225-6298*
*Both numbers: Voice & Fax

COLOMBIA

Unicom
Transversal 5A #45-46
PO Box 51468
Medellin
(57) 4 266-9154
FAX: (57) 4 266-2435

FRANCE

R.B. Com Sarl
15 Rue du Buisson Aux Fraises
Parc D'Activites de la Roseraie
91349 Massy Cedex
(331) 6 011-8866
FAX: (331) 6 011-9181

GERMANY, SWITZERLAND, AUSTRIA

Pro Nova Elektronik GMBH
Hindenburgstrasse 58
71638 Ludwigsburg
Germany
(49) 7141 285-820
FAX: (49) 7141 285-829

GHANA

HP Radio Communications & Engineering Ltd.
P.O. Box 9664 Airport
Accra
(233) 21-773-346
FAX: (233) 21-773-346

HONG KONG, CHINA

Marco Components, Inc.
Rm. 503, 5th Fl
No. 95 Chung-Hsing Rd
His-Chih Chen
Taipei Hsien
(886) 2 693-3993
FAX: (886) 2 694-5282

IRELAND

Deering Communications
113-115 Cork St.
Dublin 8
(353) 1 454-0589
FAX: (353) 1 453-1038

ISRAEL

Hyper-Tech Advanced Systems Ltd.
P.O. Box 7042
8 Hashiloach St.
Petah Tikva 49170
(972) 3 924-3352/4/6/7
FAX: (972) 3 924-3385

ITALY

Sittel A. R.L.
Via Della Pisana, 1100
00163, Rome
(39) 6 666-4388
FAX: (39) 6 666-4390

JAPAN

COMCRAFT Corporation
Toyo Kokei Bldg.
4-32-2 Ogikubo, Suginami-ku
Tokyo, 167
(81) 3-3393-6500
FAX: (81) 3-3393-6600

South KOREA

Electro-Comm
2607 Colorado Blvd. #200
Los Angeles, CA 90041
(213) 254-7790
FAX: (213) 254-8066

MALAYSIA & BRUNEI

Industronics Berhad
No. 7 Jalan Manis 4
Taman Segar
56100 Kuala Lumpur
(60) 3 930-1333
FAX: (60) 3 971-7357

MEXICO

Sistemas y Servicios de Comunicación S.A. de C.V.
Ave 20 De Noviembre No 805
31000 Chihuahua, CHIH
(52) 14 152-525
FAX: (52) 14 164-298

NETHERLANDS

Static-Care BV
Lange Willemsteeg 6-8
2801 WC Gouda
(31) 18 525-7717
FAX: (31) 18 525-7717

PHILIPPINES

Communications Solutions, Inc.
P.O. Box 2004 (808)
Makati Central Post Office
Makati 1200, Metro Manila
(63) 2 897-2881
FAX: (63) 2 810-6567

RUSSIA & Former USSR Republics

R C & C Ltd.
P.O. Box 700
Moscow 117330
(7) 095 230-3132
FAX: (7) 095 230-1107

SINGAPORE

Industrial Electronics PTE Ltd.
2 Kallang Pudding Rd.
#04-13 MacTech Industrial Bldg.
Singapore 1334
(65) 744-6873
FAX: (65) 744-5971

SOUTH AFRICA

Webb Industries
12 Delphi St.
Eastgate Ext 18, Sandton
P.O. Box 860
Wendywood 2144 Transvaal
(27) 11 444-2299
FAX: (27) 11 444-2288

SPAIN

Adler Instrumentos SL
C/Antonio de Cabezon 83
Planta 3
28034 Madrid
(34) 1 352-4046
(34) 1 358-1383

SRI LANKA

Sunpower Systems (PVT) Ltd.
5th Floor, IBM Bldg
Navam Mawatha
Colombo 02,
(94) 1 441 020
FAX: (94) 1 441 025

TAIWAN

Brotech Electronic Corp.
Rm. 503, 5th Fl
No. 95 Chung-Hsing Rd
His-Chih Chen
Taipei Hsien
(886) 2 693-3993
FAX: (886) 2 694-5282

VENEZUELA

PLC de Venezuela
Av. Principal Los Ruices
Edifico CO-BO, Piso 4
Caracas
(58) 2 239-3120/3135
FAX: (58) 2 239-5067

YEMEN

Technical Supplies Center
P.O. Box 7186
So. 60th St.
E. Awqaf Complex
Sana'a
(967) 1 269-500
FAX: (967) 1 267-067

UNITED KINGDOM

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PART 8	***Twisted Pair/Cable Protectors (continued)***		
34	IS-MPT-17, IS-MPT-24, IS-MPT-75, IS-MPT-200	7.95	7.00
34	25P10GB	28.95	24.75
35	IS-RCT	54.95	46.75
35	IS-RCT-J1	58.95	50.25
35	IS-RCT-J2	62.95	53.75
PART 9	***dc Power Protectors***		
36	IS-(12,17,24,35,48)VDC-30A-FG	112.95	96.25
36	IS-(12,17,24,35,48)VDC-30A-(NG, PG)	96.95	82.50
36	IS-60VDC-30A-FG	144.95	123.25
36	IS-60VDC-30A-(NG, PG)	112.95	96.25
36	IS-(12,17,24,35,48)VDC-50A-FG	153.95	131.00
36	IS-(12,17,24,35,48)VDC-50A-(NG, PG)	136.95	116.50
36	IS-60VDC-50A-FG	188.95	160.75
36	IS-60VDC-50A-(NG, PG)	153.95	131.00
PART 10	***ac Power Protectors***		
37	IS-MSRP-120US15A	205.95	175.25
37	IS-MSRP-120US20A	231.95	197.25
37	IS-MSRP-240US15A	236.95	201.50
37	IS-MSRP-240(AU10A, CE15A, IN15A)	308.95	262.75
37	IS-MSRP-240(IS15A, UK10A)	308.95	262.75
38	IS-PLDO-120US15A	172.95	147.25
38	IS-PLDO-120US20A	215.95	183.75
38	IS-PLDO-240US15A	202.95	172.75
38	IS-PLDO-240AU10A	274.95	233.75
38	IS-PLSO-240(IS15A, UK10A, CE15A, IN15A)	274.95	233.75
38	SIXPLEX	9.95	8.50
41	IS-PM120-SP, IS-PM240-SP, IS-PM240-BP	329.95	280.50
41	IS-PM208-3Y	346.95	295.00
41	IS-PM400-3Y, IS-PM480-3Y	463.95	394.50
42	IS-IL120-SP-100A, IS-IL240-SP-100A	899.95	765.00
42	IS-IL120-SP-200A, IS-IL240-SP-200A	1,104.95	939.25
42	IS-IL120-SP-400A, IS-IL240-SP-400A	1,499.95	1,275.00
42	IS-IL240-BP-100A	937.95	797.50
42	IS-IL240-BP-200A	1,147.95	976.00
42	IS-IL240-BP-400A	1,499.95	1,275.00
42	IS-IL208-3Y-100A, IS-IL400-3Y-100A, IS-IL480-3Y-100A	1,139.95	969.00
42	IS-IL208-3Y-200A, IS-IL400-3Y-200A, IS-IL480-3Y-200A	1,364.95	1,160.25
42	IS-IL208-3Y-400A, IS-IL400-3Y-400A, IS-IL480-3Y-400A	1,799.95	1,530.00
PART 11	***Component Protectors***		
43	IS-PSP-120, IS-PSP-240	32.95	28.25
44	IS-7WFU	121.95	103.75
44	IS-12WFU	224.95	191.25
44	BF ADAPTER	9.95	8.50
44	FB ADAPTER	11.95	10.25
PART 12	***Test Equipment***		
45	DIGI-FIST	*Contact Factory*	
46	LSC-12	72.95	62.25
46	LSC-13	*Contact Factory*	
PART 13	***Grounding Components***		
47	8PEP	562.95	478.75
48	3PEEP	553.95	471.00
48	5PEEP	694.95	590.75

PAGE	MODEL NUMBER	Column 1	Column 2
PART 13	***Grounding Components (continued)***		
48	8PEEP	847.95	721.00
48	10PEEP	980.95	834.00
48	16PEEP	1,253.95	1,066.00
48	24PEEP	1,958.95	1,665.25
48	3PB	748.95	636.75
48	5PB	862.95	733.75
48	8PB	1,006.95	856.00
48	10PB	1,267.95	1,078.00
48	16PB	1,527.95	1,299.00
48	24PB	2,354.95	2,001.75
50	UNI-KIT 2CC	28.95	24.75
50	UNI-KIT 2CT, UNI-KIT 2TC	29.95	25.50
50	UNI-KIT 2TT	30.95	26.50
50	UNI-KIT 4CC	31.95	27.25
50	UNI-KIT 4CT, UNI-KIT 4TC	32.95	28.25
50	UNI-KIT 4TT	33.95	29.00
51	CU-SPGP	63.95	54.50
51	WK-1	4.95	4.25
52	CCK	27.95	24.00
52	RACK ISO KIT 19	31.95	27.25
52	RACK ISO KIT 23	39.95	34.00
53	CS112-25	25.95	22.25
53	CS112-50, CS3-25	51.95	44.25
53	CS112-75	75.95	64.75
53	CS112-100, CS3-50, CS6-25	100.95	86.00
53	CS3-75	150.95	128.50
53	CS3-100, CS6-50	197.95	168.50
53	CS6-75	299.95	255.00
53	CS6-100	391.95	333.25
53	J-1	8.95	7.75
53	J-2	11.95	10.25
54	1C-112S, MSC-3	10.95	9.50
54	10C-112S, 58R-112S	12.95	11.25
54	TK-1, TK-2	5.95	5.25
54	TK-3, TK-4	8.95	7.75
PART 14	***Customer Services & Educational Materials***		
55	CONSULT-A, CONSULT-B, CONSULT-C	*Contact Factory*	
55	TRAINING	*Contact Factory*	
56	GROUNDING - AN OVERVIEW (VIDEO TAPE)	53.95	46.00
56	GLEP/E, GLEP/S (BOOK)	22.95	21.25
56	STRIKING NEWS	*FREE - Contact Factory*	
57	TESTING	*Contact Factory*	
57	SPECIALS	*Contact Factory*	

- All prices shown are US Dollars.
- $300.00 minimum factory order. Contact closest distributor.*
- Prices shown F.O.B. Minden, Nevada, USA.
  To determine your price, total your order using Column 1:
  - ➲ If your total is between $0.01 and $300.00, you are eligible for the Column 1 price. Contact closest distributor.*
  - ➲ If your total is between $300.00 and $2,350.00, you are eligible for the Column 2 price.
  - ➲ Additional discounts available, contact factory.
- Female connectors are standard on all units. Male connectors can be provided if indicated in catalog, at an additional $5.00 for N, F, or BNC males, $10.00 for TNC & UHF males, and $20.00 for 7/16 DIN male connectors. Add suffix -MA for male on antenna port, -ME for male on equipment port.
- Prices subject to change without notice.

* See Catalog Insert

NEW!

MICRO LIGHTNING BLOCK PROTECTOR

- ☐ **Single Broadband Product for 980MHz to 2.6GHz**
- ☐ **Industry's Best RF Performance**
- ☐ **dc Blocked for Maximum Equipment Protection**
- ☐ **Industry's Lowest Throughput Energy $\leq 0.5\mu J$ at 3kA for 8/20μs**
- ☐ **Small Footprint & Fully Weatherized Housing**
- ☐ **Completely Maintenance Free with Multi-Strike Capability**

PolyPhaser®
CORPORATION

Continued 17-Year Tradition of Providing the Industry's Finest Products for Lightning Protection

IS-MF50LN

TECHNICAL SPECIFICATIONS

Frequency Range:	**980MHz to 2.6GHz**
VSWR:	**≤1.1 to 1**
Power:	**100W**
Insertion Loss:	**≤0.1dB**
Throughput Energy:	**≤0.5µJ 8/20µs @ 3kA**

ENVIRONMENTAL DATA

NON-OPERATING

Relative Humidity:	Up to 95%
High Temperature:	+105°C
Low Temperature:	-50°C
*Altitude:	50,000 feet
Water Submerge Test:	13 inches (depth)

**Shock and Vibration associated with transportation and handling*

OPERATING

Relative Humidity:	Up to 95%
High Temperature:	+85°C
Low Temperature:	-50°C
Vibration:	1G at 5Hz to 100Hz

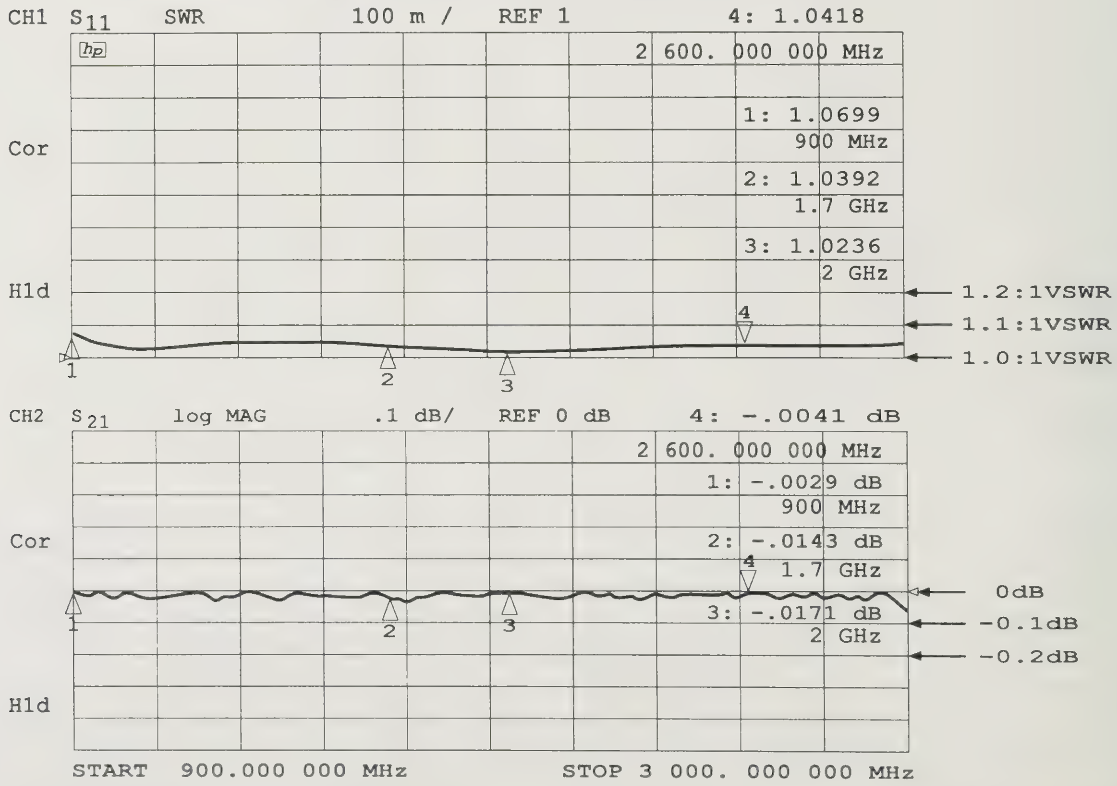
Tests were conducted per the following specifications:

GR-63-CORE: Bellcore/Network Equipment Building System Requirement
Mil-Std-202E: Test methods for Electronic & Electrical Components & Parts
Mil-Std-810E: Military Standard Environmental Test Methods and Engineering Guidelines

Mean Time Between Failure (MTBF) >>90,000hrs (>>10yrs)

MTBF calculated per TR-NWT-000332: Reliability Prediction for Electronic Equipment

VSWR & INSERTION LOSS



PolyPhaser®
CORPORATION

Sept. 1996

IS-MR50MDZ SERIES

WEATHERIZED GPS PROTECTION

Wireless communications require optimal performance. PolyPhaser introduces an innovative product to protect your equipment investment from lightning surges. Our newest microwave protector series is designed for systems requiring up to 300 watts maximum continuous power including in-line amplifiers and Global Positioning Systems (GPS) receivers. The fully tested GPS protectors provide the industry's best VSWR and insertion loss performance in the 1.2 to 2.0GHz passband. The IS-MR50MDZ Series is fully weatherized and is available in several pass voltages at currents to 5 amps.

PolyPhaser®
CORPORATION

IS-MR50MDZ SERIES

Features

- 1.2GHz to 2.0GHz Frequency Range
- Multi-Strike Capability
- Low VSWR and Insertion Loss
- Protects In-Line Amplifiers
- Industry's Lowest Throughput Energy
- Fully Weatherized Housing

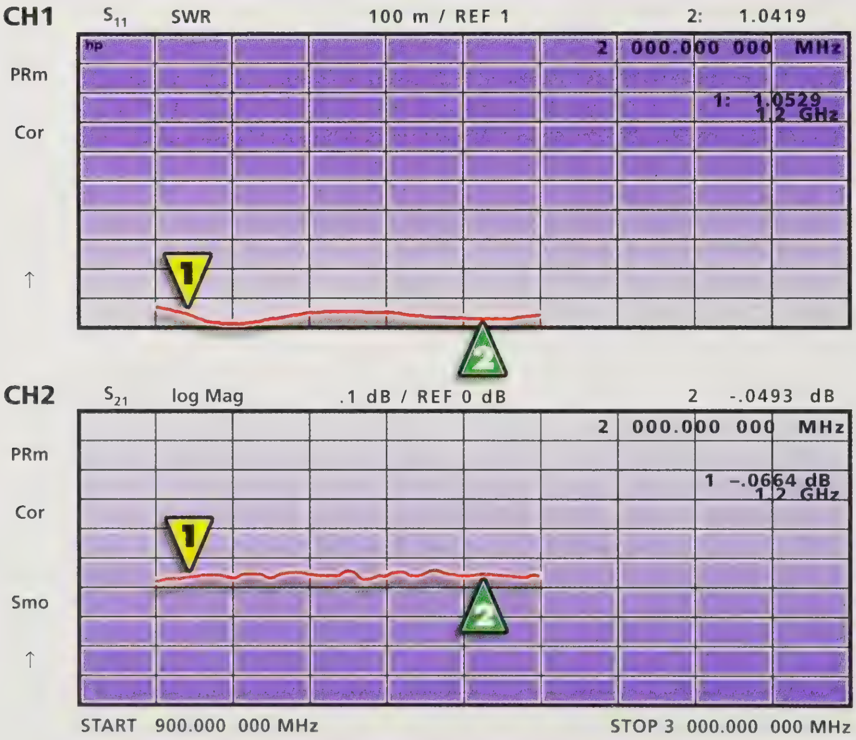
Technical Specifications

Surge:
20kA IEC 1000-4-5 8/20µs waveform
Turn-On: +6Vdc, +15Vdc
Turn-On Time: 4ns for 2kV/ns
Frequency Range: 1.2GHz to 2.0GHz
VSWR: ≤1.1 to 1
Insertion Loss: ≤0.1dB
RF Power: 300W Maximum Continuous
User Current: 2.0Adc Continuous
Vibration: 1G @ 5Hz to 100Hz
Temperature: -50°C to +65°C
Relative Humidity: Up to 95%

Throughput Energy

RF: ≤0.5µJ for 3kA @ 8/20µs waveform
dc: ≤350µJ for 3kA @ 8/20µs waveform

VSWR & Insertion Loss



PolyPhaser
CORPORATION

IS-MF50HD SERIES

MEDIUM POWER LIGHTNING FILTER

Protect your communications equipment and keep your valuable wireless customers connected with PolyPhaser's newest microwave filter protectors. These are engineered for systems requiring up to 300 watts maximum continuous power including Cellular, Paging and Personal Communications Services bands. The fully weatherized IS-MF50HD Series protectors feature compact integrated connector housings and are dc blocked. An innovative design with no gas tubes, this series provides the ultimate equipment protection while continuing to maintain the industry's best passband VSWR and extremely low insertion loss.

PolyPhaser®
CORPORATION

IS-MF50HD SERIES

Features

- New UniBody Construction
- Small Footprint & Fully Weatherized Housing
- Industry's Lowest Throughput Energy
- Completely Maintenance Free
- Multi-Strike Capability
- No Gas Tube
- dc Blocked
- Elongated DIN with "D" Hole Mounting
- Weather Seal Hardware Included for Bulkhead or Cabinet Mounting

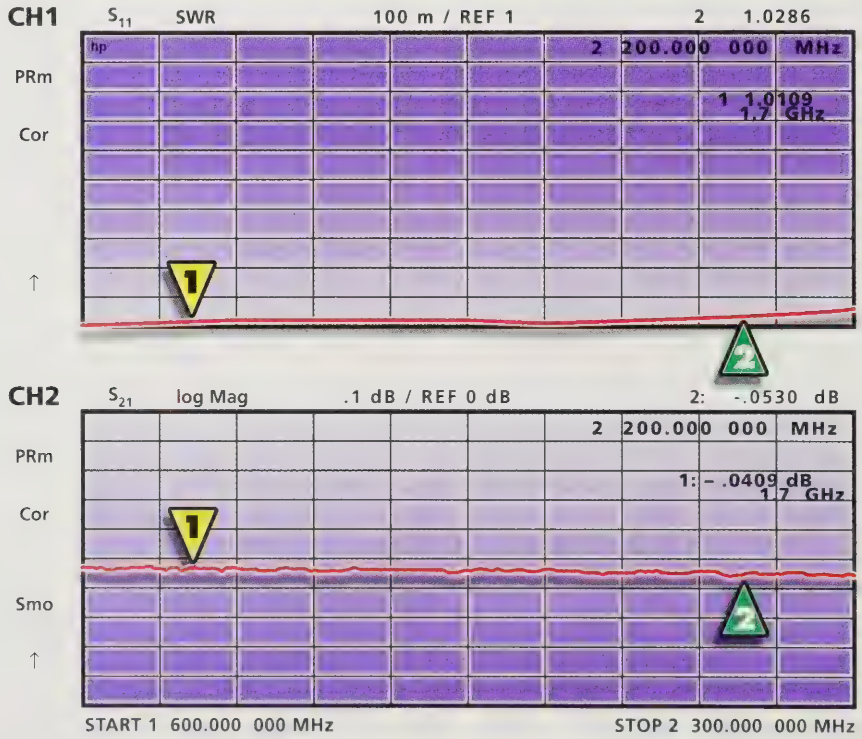
Technical Specifications

Surge:
20kA IEC 1000-4-5 8/20µs waveform
VSWR: ≤1.1 to 1
Insertion Loss: ≤0.1dB
Frequency Range: 1.7GHz to 2.2GHz
Power: 300W Maximum Continuous
Temperature: -40°C to +85°C

Throughput Energy

≤10µJ @ 3kA @ 8/20µs waveform

VSWR & Insertion Loss



PolyPhaser®
CORPORATION

PolyPhaser Corporation

POLYPHASER CORPORATION HEADQUARTERS IS LOCATED IN THE CARSON VALLEY

Nestled in the Carson Valley and just minutes from Lake Tahoe, PolyPhaser Corporation and its 140 employees are headquartered in Minden, Nevada. The company is dedicated to providing lightning/electromagnetic pulse protection and grounding solutions for the communications industry. Founded in 1979 by Roger and Gayle Block, PolyPhaser designs and manufactures more than 2,500 models of coax, power and twisted pair protectors from within a 53,000 square foot state-of-the-art facility.

PolyPhaser custom designs products to meet customer needs in a variety of fields, including cellular, paging, broadcast, wireless, mobile communications, military, PCS, GPS, 9-1-1 sites, ham radio and power companies. Custom protectors are routinely designed, tested and produced, and often become part of PolyPhaser's future catalogs.

Among PolyPhaser's lightning protection products are coax entrance panels, cellular protectors, in-line power mains, global positioning system coaxial protectors, shunt-type power mains, rack panel protectors, UHF combiners, educational material, LAN/data line protection, custom products, grounding components and power-supply protectors.

To further safeguard a client's communications equipment, PolyPhaser offers complete technical support, testing, training, consulting and a web site at http://www.polyphaser.com.

A current seminar PolyPhaser is offering consists of three eight-hour days. The first day addresses lightning and grounding fundamentals; day two discusses grounding theory, applications, methods and products; and day three delves into grounding case histories and offers hands-on learning activities.

When Lightning Strikes . . . Count on a PolyPhaser®. ■

PolyPhaser®
CORPORATION

2225 Park Place • Minden, NV 89423
(702) 782-2511 • Fax (702) 782-4476
E-Mail: info@polyphaser.com

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How to use this catalog

The concept of lightning protection can be summed up in a few words: You have control over the lightning strike's energy, not Mother Nature. This means that you are providing a path to earth and not allowing it to choose a random path. It is not possible to stop a strike, nor is it possible to prevent a strike from occurring. Therefore you must be prepared to divert the strike energy to earth via a deliberate and controlled path so that no damage will be incurred. Building or structure protection is more forgiving than protection of electronics. A building can handle 100,000 volts while electronics will be damaged with just a few volts.

There are many similarities between Lightning and EMP protection. Everyone has experienced lightning, but few know what is meant by EMP. EMP (Electro Magnetic Pulse) is a radiated electromagnetic broadband pulse which has a very high energy content. It is generated from the detonation of a nuclear weapon. If this occurs at a high elevation, the interaction of the weapon's radiation with the upper atmosphere (partial vacuum) will cause a larger area radiation/propagation of this pulse than if it were a surface detonation. A surface event will have a faster rise time pulse but will affect a more local area due to the earth's curvature. The radiated radio frequency pulse energy will be intercepted by any and all conductors and transformed into a voltage. Power lines, telephone lines and antennas will capture enough energy to cause equipment failure. Protection of your equipment is a must for both EMP and lightning. You can use similar type protectors. The difference is in the rise time of the events. EMP is in the low nanosecond range while lightning, at its fastest, is at least ten times slower. Protectors that are usable for EMP will work fine for lightning. They cost more and will *not* be that much better for lightning protection.

There are but a few basic questions whose answers will determine the type of protector that you will need to keep your equipment protected from Nature's worst storms. These questions are highlighted here as subtitles.

COAX PROTECTION

IMPEDANCE. 50 and 75 ohm protectors are available. Most all the applications will be for 50 ohms.

SPEED. Is the protection for lightning only or lightning and NEMP (Nuclear Electro Magnetic Pulse) threats. Most of the protectors do well for both but for some military applications, high speed protection may be necessary.

FREQUENCY RANGE. There are broad coverage units to single frequency filtered models. Generally, we can make units to 20GHz. Most of lightning's energy is in the lower frequency range of dc to 1.0MHz. The further away from this range, the less the amount of energy that will get through to the equipment (throughput energy). Always choose the lowest throughput energy for the desired frequency range.

TRANSMIT (XMIT), TRANSCEIVE (XCV) OR RECEIVE ONLY (RO). The number of XMIT signals is important. Protectors are voltage sensitive and multi-XMIT signals are voltage additive, not power additive. Two 100 watt XMIT signals combined equal 200 watts of heating power but the additive voltages have peaks of 200V, which equate to a single 400 watt signal. Therefore, multi-channel simultaneous XMIT systems must have a higher turn-on voltage and be designed to handle the peak instantaneous RF currents which can be reached. These are listed for this usage in the catalog under "COMBINER PROTECTORS - Part 5."

TRANSMIT POWER. Each model that can support a 10 watt or higher level is listed as to its power level capability. Generally, as the frequency is increased, the power handling is reduced. This is done for many reasons. The most important of which is to be sure the protector will turn off after a lightning or EMP firing and not be "kept alive" in a glow mode by the presence of the RF transmit energy. The turn-on voltage is tied in with power handling. But since most of our units do not have dc continuity, little protection is lost by going to a higher turn-on voltage unit especially if XMIT combining is planned in the future. *Note:* Some models such as the IS-CT50HN (800 to 900MHz multi-channel) have a higher turn-on voltage than an IS-B50LN (125 to 1000MHz single channel XMIT) but have a much lower throughput energy (10µJ vs. 600µJ). This makes the IS-CT50HN excellent for RO.

PRESENCE OF AC OR DC POWER WITH THE RF SIGNALS. This is usually for RO situations such as tower top preamps. However, we have made units (specials) for the 800 to 900MHz and in the microwave range for the higher current requirements of tower top transmit amplifiers. Units are listed for dc injector/pickoff and for protecting already injected coax lines (pickor model).

MOUNTING. Bulkhead panels are recommended. (Bulkhead panel systems are listed as auxiliary equipment.) Flange style may be mounted on a bus bar or our new single point ground panel shown on Page 51. A ground strap larger than the total sum of all the circumferences of the coax shields should be used to connect to a low inductance (Z) ground system. For more on grounding, see our listed book, *The 'Grounds' for Lightning & EMP Protection.*

CONNECTOR TYPE AND SEX. UHF style connectors are poor at the UHF frequencies (300 to 3000MHz). Watt meters that use these connectors will give misleading readings even with type N adaptors at the UHF bands. Type N connectors are recommended even though they have limited center pin lightning current handling compared to the UHF connectors. BNC, SMA and F male and female are stocked connectors. These and others are available for some models but will incur an additional cost. The connector sex can be chosen for male and/or female combinations (except some microwave models). Some models are factory stock. The male is always the one with the outside moveable shell and center pin. (See inside back cover for connector pictorials.)

DATA/PHONE LINE PROTECTION

For lightning, twisted pair cable bundles will mutually couple surge energy to all pairs. Unused pairs should be grounded (if allowed). For bundles over 6 pair, our IS-MPT Series should be used on 66 type punch down blocks with an appropriate grounding bus as described on Page 34. For 6 pairs or less, more energy will be present per pair so a hybrid protector, as shown on Page 32 & 33, can handle energy levels which will vaporize standard 24 AWG wire pairs.

For EMP, all of the listed twisted pair protectors will limit an EMP pulse to the "Surge Let Through Voltage Equipment Side" listing. Special bulkhead models are available for screen room penetrations in the single and dual pair configurations.

Selection of data/phone line protectors depends on the presence of either -48V battery and/or ringing voltages. The line impedance and total allowable loop resistance and highest frequency or bit rate will determine the insertion loss from the protector's line resistance/inductance and capacitance. You may call for further assistance.

POWER LINE PROTECTION

For lightning and EMP, shunt type protectors will limit the voltages to a safe level for most non-electronic equipment. In-line type protectors are mandatory for electronic equipment survival. These in-line units should be mounted/grounded close to the equipment. For mainframe computers and broadcast equipment, in-line power mains protectors are listed which provide single or polyphase protection with EMI/RFI filtering.

For power line protector selection, the voltages, number of phases, configuration, and for in-line, current usage, will pinpoint the model. Voltages to 480Vac are listed for single to three phase applications. All models (except IS-PSP-120 and IS-PSP-240) have built in end-of-life protection. Replacement modules and breakers are sold separately for most models.

GROUNDING

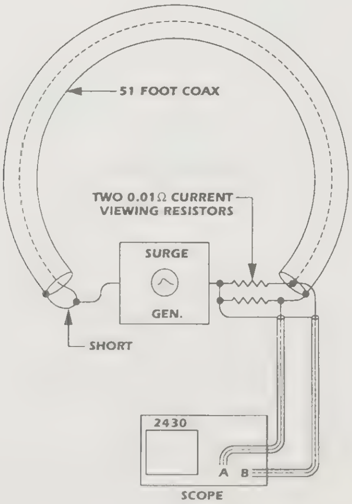
Grounding is so important that we wrote a book about it titled *The 'Grounds' for Lightning & EMP Protection.* Also, video tapes on this and other protection/installation subjects are now available in VHS format.

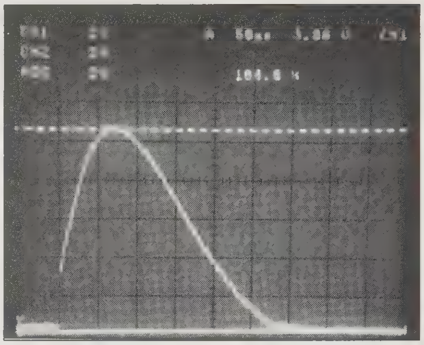
The need for coax protection

Skin effect is a physical phenomenon that relates to the limited penetration into a conductor of an RF signal according to its frequency. Coax uses this effect to keep the RF signal inside and any coupled outside interference on its shield's outside surface. This begins to fall apart as the frequency is lowered and the penetration, which is a gradient, begins to mix the shield's outside interference energy with the desired inside energy. A ground loop, which imparts 60Hz onto a desired signal, is due to dissimilar grounds causing ac current flow between points via the coax shield.

With lightning, the main frequency range is dc to about 1.0MHz or so. This is right in the range that affects the coax and is called transfer impedance. The thicker the shield material, the less the effect of these low frequency currents. (Also the less the bending radius and the harder it is to work with.)

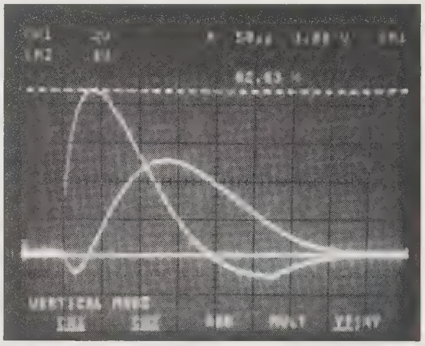
A test was performed on 51 feet of 1/2" hard line, where we shorted the center conductor to the shield on one end simulating a shunt-fed antenna. For the test, 1050 amperes of current was pulsed to individual 0.01 ohm resistors at the far end. These current viewing resistors went to separate channels on a digital storage scope. The most obvious result was that the velocity factor of the shield was such that the pulse arrived first. The center conductor had more inductance so the pulse was spread out in time. The energy (area under the curves) was exactly the same for both the shield and the center conductor. Since the pulses arrived at different times, a differential voltage occurred that must be equalized and prevented from reaching your equipment. This is precisely what the patented PolyPhaser products do in order to provide the ultimate protection.



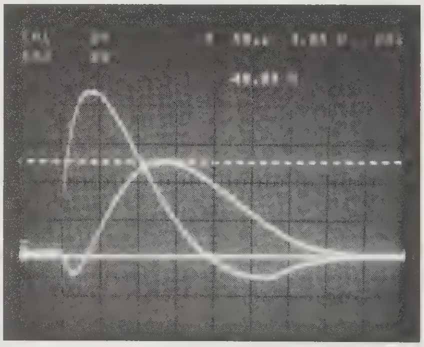


The above pulse was used on a 51 foot long 1/2" hard line. One end was shorted to simulate a shunt-fed antenna, while the other end went to separate 0.01 ohm current viewing resistors.

NOTE: This pulse is the algebraic summation and its peak 1050 Amps is referenced to 100%.



SHIELD
The voltage across each 0.01 ohm resistor. Here the shield has 82.63% relative to the total pulse.



CENTER
Here the center conductor's peak is only 48.89% of the total. Note that the area under both waveforms is nearly equal. Each has 50% of the total surge energy.

The PolyPhaser difference.

PolyPhaser Corporation's Impulse Suppressor Family is like no other EMP or Lightning Arrestor. Aside from the fact that a hermetically sealed voltage sensitive gas tube is used on most models, additional components assure that surge voltages and currents that form differentially on the coax are prevented from being shared by your equipment. By this we mean that other gas tube arrestors that have dc continuity through their center pins, cannot function on equipment that has inductors to ground as the first component in their input circuitry. With these arrestors, the incoming surge rise time must develop an Ldi/dt voltage drop large enough to turn on the dc continuity arrestor's voltage sensitive gas tube. This means either extremely fast rise times are necessary or very large surge currents must pass through this inductor to equipment (chassis) ground. The coil may not handle this high voltage or the high current and fail open. Either way, an uncontrolled arcing is created. If a quarter wave stub protector is used, it also has dc continuity through its center pins, the same surge generated Ldi/dt voltage drop will be created through the quarter wave section's inductance and will be shared with the equipment's input inductor. This still places some surge current on the equipment chassis which must be conducted to ground. PolyPhaser's Impulse Suppressors have no dc continuity and thus do not share the surge with your equipment. In fact, PolyPhaser's best protector (IS-IE series) prevents, not only the center conductor's energy, but also the coax shield's surge energy from traveling to the equipment chassis. This truly unique protector has total dc isolation.

All gas tubes have a turn-on time. A gas tube's dc turn-on voltage is always lower than the dynamic turn-on voltage. For equipment which has a capacitor coupling, dc blocked, connection to the coax center pin (i.e. power amps), it is the portion of the surge waveform that occurs before the crowbarring of the gas tube that can puncture through the equipment's dc blocking caps and cause damage to solid state components. PolyPhaser's impulse suppressors use internal capacitors that have a dc working voltage that is two to three times the dynamic turn-on voltages of its gas tube. If the arrestor is triggered, due to a lightning strike or from wind blown static build-up, while RF transmissions are occurring, the gas tube must fire and extinguish properly. Normally, the RF would keep the gas excited (glow mode) thus causing a loss of transmit power and the generation of wide band noise. However, it is the choice of gas tube, that makes the difference. Not all gas tubes are the same! There are many variables, such as atmosphere gas mixture, gas pressure, gap geometry, gap distance, carbon striping, electrode alloy make-up, and electrode coatings. All of these variables go into a balance between turn-on voltage, turn-on time, current handling capability, lifetime as well as extinguishing capability in the presence of RF.

PolyPhaser's patented models all have specifications as to their power handling limits to ensure proper turn-off. To do this, you may see that our dc turn-on voltage is higher than most, but since we don't share the surge energy, the turn-on threshold has little to do with the amount of protection given to the equipment. We are proud to specify the small amount of residual throughput energy that will reach the equipment. No one else does, or can!

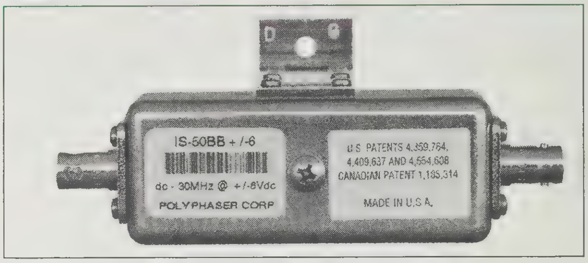
Many have asked why the gas tubes are not field replaceable on a PolyPhaser®. The reasons are many and go back to a quality issue. If an Impulse Suppressor must handle a 50,000+ ampere strike, the gas tube to body connection must not arc and spark like some connector manufacturer's protectors. The oxidation that occurs to exposed parts as well as the human skin oils that can be imparted onto a removable gas tube will only add to the time and voltage that will be seen through a dc type protector. For PolyPhaser's non-dc type protectors this is not so important as is the mere thought someone might inadvertently forget to replace the gas tube after inspection. It is this regard for quality, to ensure that a PolyPhaser® works properly every time, that we think is most important. Our 10 year warranty shows that we know how reliable our products are and are willing to stand behind them.

50/75 OHM BASEBAND COAXIAL PROTECTORS

APPLICATION:

HF receive only, LAN, closed circuit video.

- Bi-directional signals/protection
- Grounded shield 10Mbits
- Complies with IEEE 802.3 (50Ω)
- Broadband – low VSWR and loss
- Multi-strike capability
- Low voltage thresholds
- Low throughput energy
- Housed use only
- Weatherize using WK-1, page 51
- Aluminum enclosure
- 18-8 stainless steel hardware
- **Flange mount** (bulkhead mount adapter, page 44)


IS-50BB +/-6
dc - 30MHz @ +/-6Vdc
POLYPHASER CORP
U.S. PATENTS 4,359,764, 4,409,637 AND 4,554,608
CANADIAN PATENT 1,185,314
MADE IN U.S.A.

Model shown **IS-50BB/6**, flange mount

Typical Application	Impedance	Operating Voltage
Closed Circuit Video	75Ω	±1.5
HF Receive Only	50Ω	±6
LAN*	50Ω	±18

NON-STOCKED OPTIONS: 70Ω type N connectors

MIL SPECS: Many — call with requirements.

PRODUCT DIMENSIONS: See page 63.

MAXIMUM CHARACTERISTICS

Surge:
18kA IEC 1000-4-5 8/20μs waveform 110 Joules
Turn-on Time:
4ns for 2kV/ns
VSWR:
<1.1 to 1 over frequency range
Insertion Loss:
≤0.3dB over frequency range
User Current:
3.0Adc continuous
Temperature:
-55°C to +125°C Storage/Operating +50°C

Order:

Tuned for 50Ω dc to 30MHz:

Connectors	Model	Operating Voltages *(Select One)*		
BNC	**IS-50BB/**	**1.5**	**6**	**18**
N	**IS-50NB/**	**1.5**	**6**	**18**
TNC	**IS-50TB/**	**1.5**	**6**	**18**
UHF	**IS-50UB/**	**1.5**	**6**	**18**

Tuned for 75Ω dc to 15MHz:

Connectors	Model	Operating Voltages *(Select One)*		
BNC (50Ω)	**IS-75BB/**	**1.5**	**6**	**18**
F	**IS-75FB/**	**1.5**	**6**	**18**
N (70Ω females only)	**IS-75NB/**	**1.5**	**6**	**18**
UHF	**IS-75UB/**	**1.5**	**6**	**18**

Add suffix -MA for a male connector.
Add $5.00 for each N, BNC male.
Add $10.00 for each UHF, TNC.

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

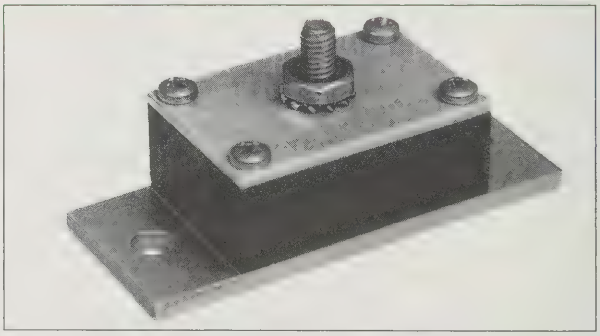
ISOLATED GROUND ADAPTER FOR PROTECTORS- NEW

APPLICATION:

Provides ground isolation to 90Vdc to prevent noise & ground loop/hum problems on lines running between buildings.

- 90V turn-on
- Multi-strike capability
- Copper mounting plate
- PVC insulator
- When used with above protector replaces IE50 series

PRODUCT DIMENSIONS: See page 63.

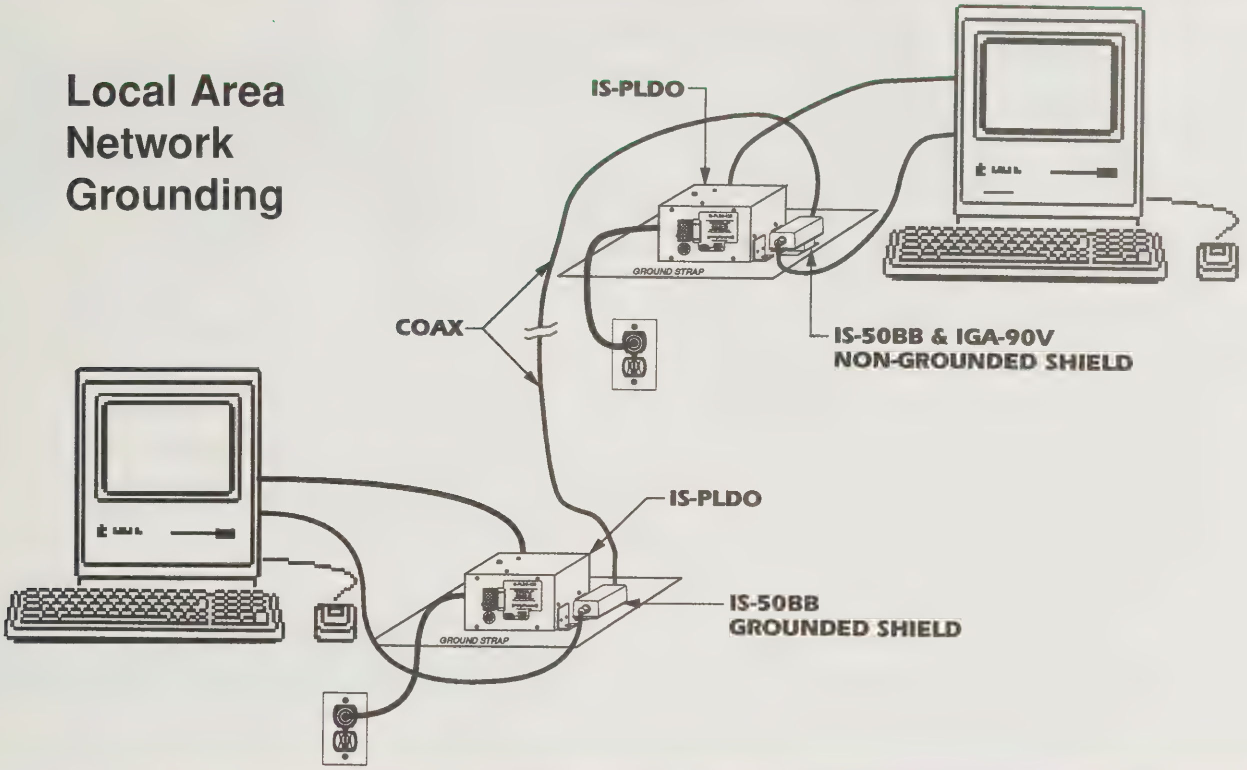


Model shown **IGA-90V**, flange mount

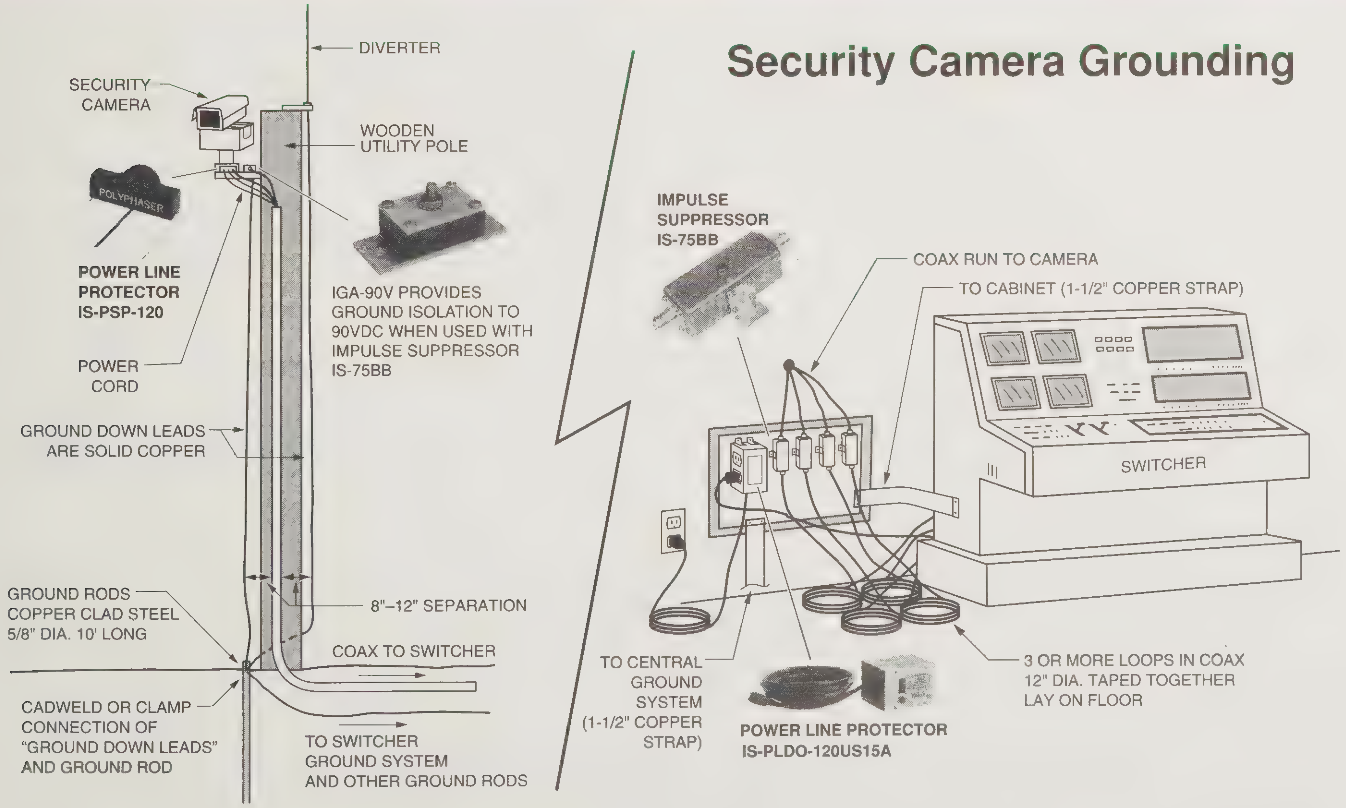
Order: IGA-90V

TYPICAL APPLICATION

Local Area Network Grounding



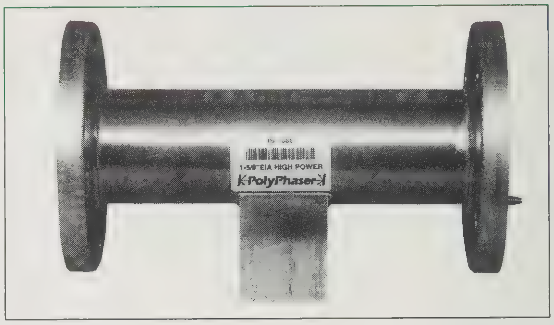
Security Camera Grounding


DIVERTER
SECURITY CAMERA
WOODEN UTILITY POLE
POLYPHASER
POWER LINE PROTECTOR IS-PSP-120
IGA-90V PROVIDES GROUND ISOLATION TO 90VDC WHEN USED WITH IMPULSE SUPPRESSOR IS-75BB
POWER CORD
GROUND DOWN LEADS ARE SOLID COPPER
GROUND RODS COPPER CLAD STEEL 5/8" DIA. 10' LONG
8"–12" SEPARATION
COAX TO SWITCHER
CADWELD OR CLAMP CONNECTION OF "GROUND DOWN LEADS" AND GROUND ROD
TO SWITCHER GROUND SYSTEM AND OTHER GROUND RODS
IMPULSE SUPPRESSOR IS-75BB
COAX RUN TO CAMERA
TO CABINET (1-1/2" COPPER STRAP)
SWITCHER
TO CENTRAL GROUND SYSTEM (1-1/2" COPPER STRAP)
POWER LINE PROTECTOR IS-PLDO-120US15A
3 OR MORE LOOPS IN COAX 12" DIA. TAPED TOGETHER LAY ON FLOOR

HIGH POWER COAXIAL PROTECTOR - BROADCAST

APPLICATION:

25kW high powered HF.



Model shown **IS-158E**

- EMP and lightning
- EIA flanges: 1-5/8" and 3-1/8"
- dc to 220MHz typical bandwidths
- Fast <25ns turn-on time
- Unique PolyPhaser® gas tube design for fast response and fast restoration
- Field replaceable gas tubes available
- Air tight "through" for dry air or N pressure
- Stainless steel hardware and gasket

NON-STOCKED OPTIONS:
Center bullets are available for either EIA size; extra gas tubes, unit specific turn-on voltage plots.

PRODUCT DIMENSIONS: See page 69.

Order: **IS-318E** with 3-1/8" EIA flange
IS-158E with 1-5/8" EIA flange

Note: Gas tube must be ordered separately.
Call factory with power & VSWR antenna line measurements.

MAXIMUM CHARACTERISTICS

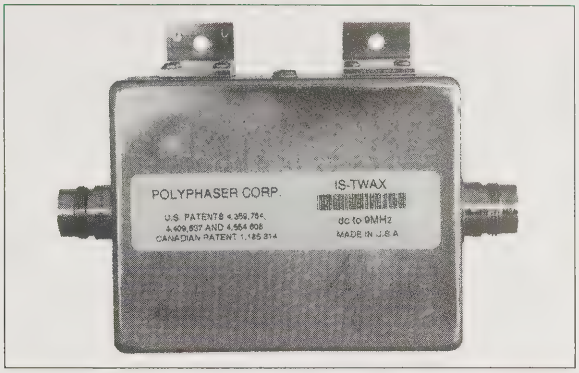
Surge:
100kA IEC 1000-4-5 8/20μs waveform 1000 Joules
Turn-on:
Varies with power requirements custom gas tube
Turn-on Time:
<25ns for 2kV/ns
Frequency Range:
dc to 220MHz (May vary with requirements.)
Temperature:
-55°C to +85°C Storage/Operating

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

IBM® TWINAX SERIES

APPLICATION:

Where Twinax Cable/Data require specialized coax protection.


POLYPHASER CORP.
U.S. PATENTS 4,359,764, 4,409,637 AND 4,554,608
CANADIAN PATENT 1,185,314
IS-TWAX
dc to 9MHz
MADE IN U.S.A.

Model shown *IS-TWAX*

- For IBM System 34, 36, 38 or 400
- Extra wide bandwidth (dc to 9MHz)
- Flange mountable
- EMP rated
- Multi-strike capability
- LM-380 aluminum enclosure
- Housed use only
- Weatherize using two WK-1's, page 51
- All 18-8 stainless steel hardware (including mounting hardware)
- Twinax (Amphenol 82-5590) connectors standard

MAXIMUM CHARACTERISTICS

Surge:
18kA IEC 1000-4-5 8/20µs waveform

Turn-on Vdc:
±7.3Vdc line-to-line and each line-to-ground

Turn-on Time:
2ns after voltage wavefront reaches dc threshold
(Based on 1kV/ns waveform)

Impedance:
100Ω balanced
50Ω unbalanced

VSWR:
≤1.2 to 1 over frequency range

Insertion Loss:
≤0.1dB

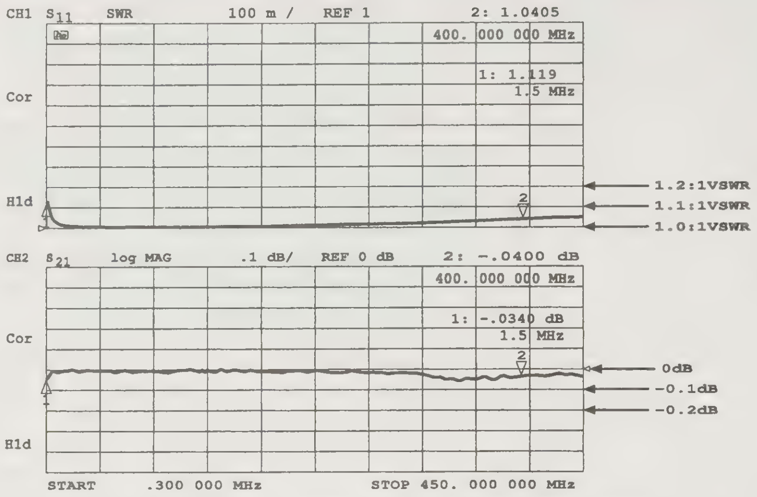
Temperature:
-50°C to +95°C Storage/Operating +50°C

Order: ***IS-TWAX*** for Twinax protector.

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

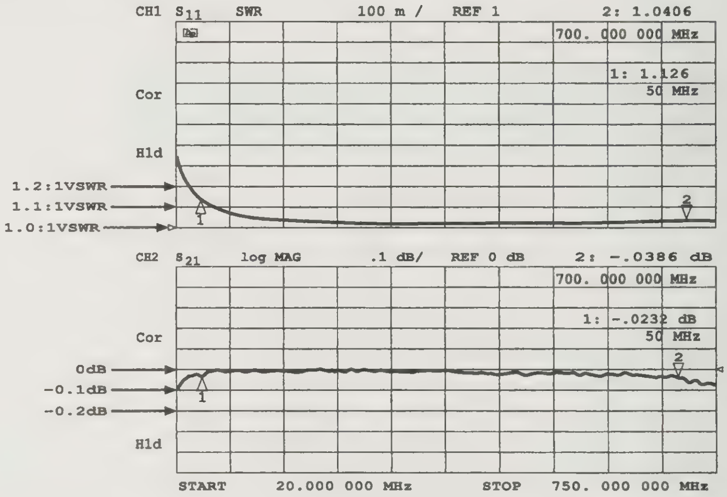
IBM® is a registered trademark of International Business Machines Corporation.

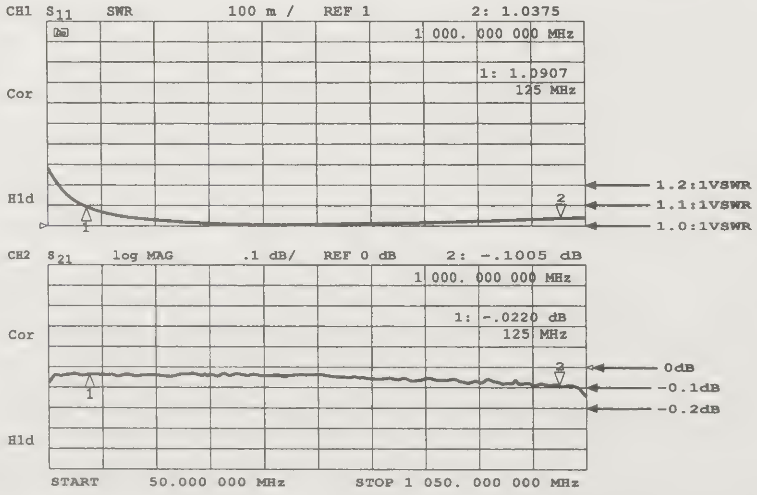
VSWR & INSERTION LOSS PLOTS



Typical VSWR & Insertion Loss plot for all -C0 models with the markers set at 1.5MHz & 400MHz.

Typical VSWR & Insertion Loss plot for all -C1 models with the markers set at 50MHz & 700MHz.





Typical VSWR & Insertion Loss plot for all -C2 models with the markers set at 125MHz & 1000MHz.

NUCLEAR EMP COAXIAL PROTECTOR

APPLICATION:

Military, government (FEMA and NCA), protection of emergency radio communications equipment.

- **Weatherize using WK-1,** page 51
- **Employs UL497B listed gas tube**
- **Patented technology**
- **Ultra-fast response**
- **Low throughput energy**
- **High surge current handling**
- **Aluminum enclosure**
- **18-8 stainless steel hardware**
- **Bulkhead mountable up to 1/4" thick panels** (flange mount adapter, page 44)
- **N silver shell and gold center pin**
- **Highest pulse attenuation (30.14dB-for IS-NEMP-C0) of all models tested by NCS (TIB 85-10 document)**
- **Works for both Lightning and NEMP events unlike dc continuity protectors which can't protect receivers and shunt fed cavities from lightning due to their own dc path**
- **Mounts outside screen room penetration panel or equipment housing for best skin effect and pulse attenuation**
- **EMI/RFI weather washer for low impedance no drip penetration**

NON-STOCKED OPTIONS: Other connector types and sex: BNC, TNC, SMA, UHF available, only UHF types (female) are threaded; Crossing connectors types to make unit an adaptor; unit specific VSWR and IL plots.

MIL SPECS: Many — call with requirements.

PRODUCT DIMENSIONS: See page 64.

Order:
N CONNECTORS (Females Standard)

IS-NEMP-C0 ≤314µJ Throughput Energy
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 500W, VHF 200W, UHF 100W

IS-NEMP-C1 ≤570µJ Throughput Energy
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 200W, UHF 100W

IS-NEMP-C2 ≤80µJ Throughput Energy
Frequency Range: 125MHz to 1000MHz
Max. Power: VHF 200W, UHF (low) 100W
800MHz to 1GHz 50W

Choose lowest throughput energy for desired frequency. Energy measured with 2kV/ns waveform.

Add suffix: **-MA** for male connector on antenna port
-ME for male on equipment port
-MA/ME special order

Add $5.00 for each N male connector.

Model shown **IS-NEMP-C0,** bulkhead mount

NOTE: See pages 12 & 13 for lightning spectrum attenuation graphs.

MAXIMUM CHARACTERISTICS

Surge:
50kA IEC 1000-4-5 8/20µs waveform 500 Joules

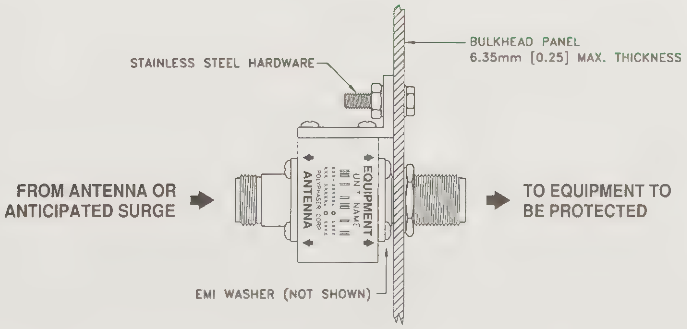
Turn-on:
330Vdc ±20%

Turn-on Time:
1.5ns for 2kV/ns

VSWR: (See plots page 10)
≤1.1 to 1 over frequency range

Insertion Loss:
≤0.1dB over frequency range

Temperature:
-55°C to +125°C Storage/Operating +50°C



U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

BROADBAND HF/VHF/UHF COAXIAL PROTECTORS

APPLICATION:

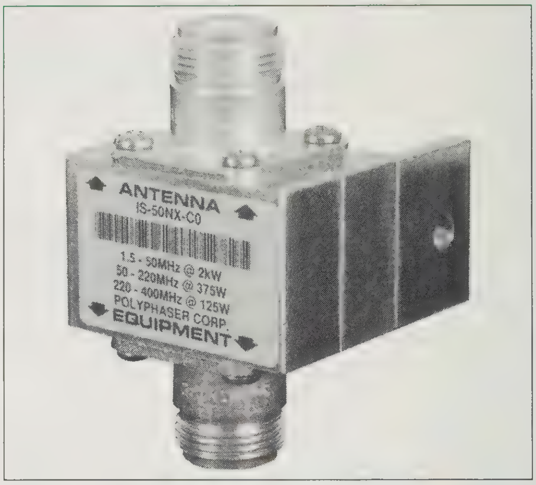
For general radio use; surface mountable. **NOT** where transmitter combining is preformed.

- **Employs UL497B listed gas tube**
- **Works on all equipment unlike dc continuity which can't protect receivers, shunt fed cavities, etc.**
- **Multi-strike capability**
- **Low strike throughput energy**
- **Flange ground/mount** (bulkhead mount adaptor, page 44)
- **Housed use only**
- **Weatherize using WK-1**, page 51
- **Aluminum enclosure**
- **18-8 stainless steel hardware**
- **UHF nickel shell silver center, TFE**
- **N silver shell and gold center pin**

NON-STOCKED OPTIONS: BNC, TNC and SMA connectors, 70Ω N connectors available, unit specific VSWR and I.L. plots.

MIL SPECS: Meets 6' all angle drop test, Op to 70,000', Mil-STD-202, 170F Cond. B -65°C ro 125,C, Rainproof option meets many Mil specs under 202 and 810 for vibration, shock (both), fungus, etc. UHF & N connectors Mil-C-39012, QQ-S-365, QQ-B-626, QQ-C-530 and Mil-G-45204, follows Mil-STD-454J, Solder QQ-S-571 Sn62

PRODUCT DIMENSIONS: See page 64.



Model shown **IS-50NX-C0**, flange mount

MAXIMUM CHARACTERISTICS

Surge:
50kA IEC 1000-4-5 8/20µs waveform 500 Joules

Turn-on:
600Vdc ±20%

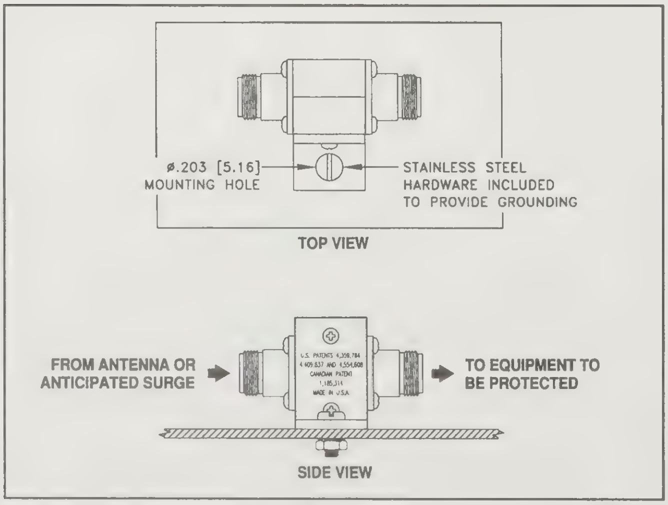
Turn-on Time:
2.5ns for 2kV/ns

VSWR: (See plots page 10)
≤1.1 to 1 Type N connectors
≤1.2 to 1 Type F & UHF connectors

Insertion Loss:
≤0.1dB over frequency range

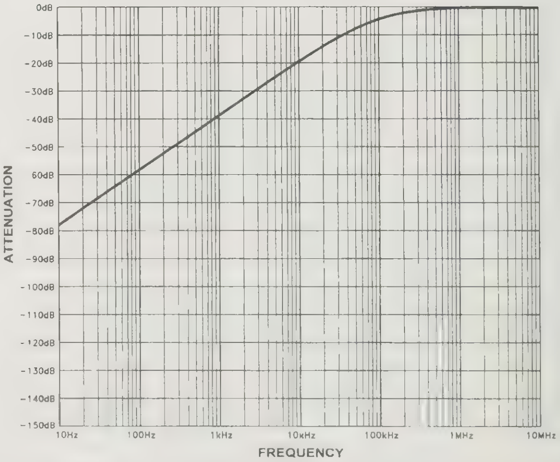
Temperature:
-55°C to +125°C Storage/Operating +50°C

TYPICAL MOUNTING CONFIGURATION



U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

All -C0 Models
LIGHTNING SPECTRUM ATTENUATION



The throughput voltage to your equipment is related to the attenuation of the low frequency energy. The greater the attenuation, the smaller the throughput energy and voltage.

BROADBAND HF/VHF/UHF COAXIAL PROTECTORS

Order:

UHF CONNECTORS (Females Standard)

IS-50UX-C0 ≤10mJ Throughput Energy
Frequency Range: 1.8MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

IS-50UX-C1 ≤600μJ Throughput Energy
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 375W, UHF 125W

F CONNECTORS (Females Standard)

IS-75F-C1 ≤1mJ Throughput Energy
Frequency Range: 4MHz to 900MHz (1.2 to 1 VSWR)
Max. Power: HF 100W, VHF 100W, UHF 25W

Choose lowest throughput energy for desired frequency. Energy based on 8/20μs waveform.

Add suffix: **-MA** for male connector on the antenna port
-ME for male on the equipment port
-MA/**ME** special order

Add $10.00 for each UHF
Add $5.00 for each F

N CONNECTORS (Females Standard)

IS-50NX-C0 ≤10mJ Throughput Energy
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

IS-50NX-C1 ≤600μJ Throughput Energy
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 375W, UHF 125W

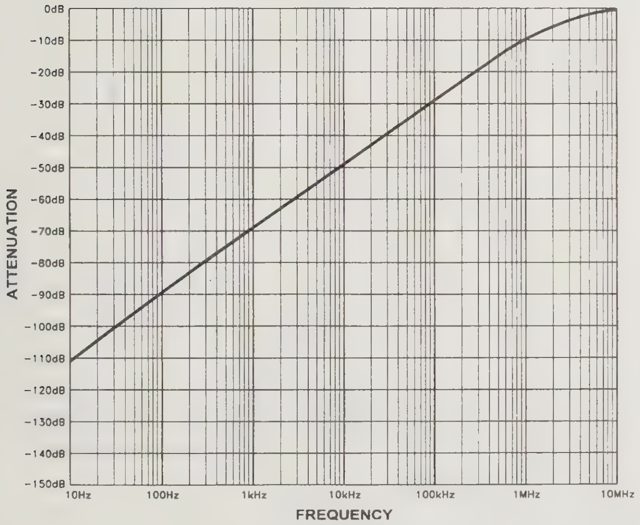
IS-50NX-C2 ≤220μJ Throughput Energy
Frequency Range: 125MHz to 1000MHz
Max. Power: VHF 375W, UHF (low) 125W
800MHz to 1GHz 50W

Choose lowest throughput energy for desired frequency. Energy based on 8/20μs waveform.

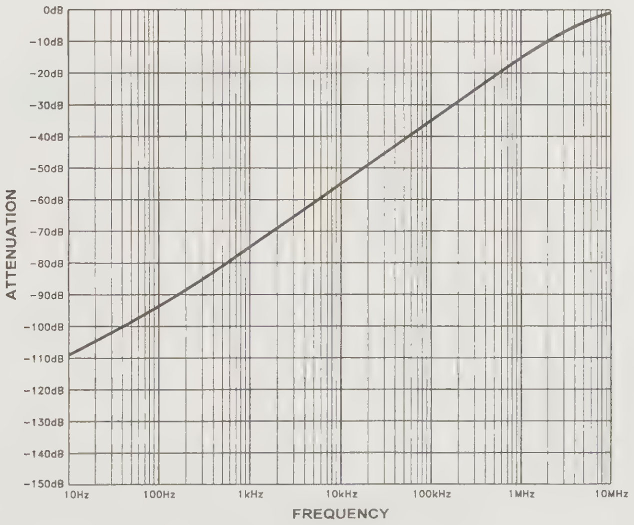
Add suffix: **-MA** for male connector on the antenna port
-ME for male on the equipment port
-MA/**ME** special order

Add $5.00 for each N male.

All -C1 Models
LIGHTNING SPECTRUM ATTENUATION



All -C2 Models
LIGHTNING SPECTRUM ATTENUATION

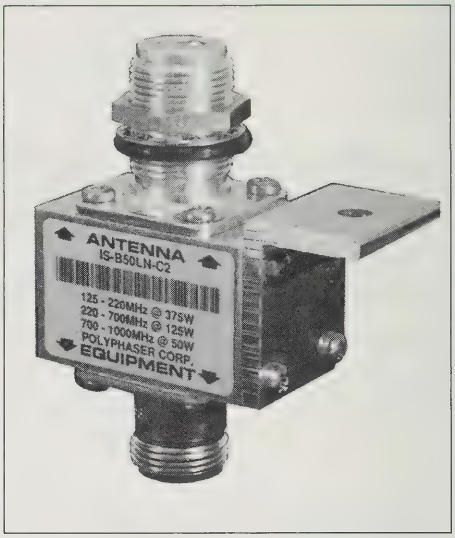


The throughput energy to your equipment is related to the attenuation of the low frequency energy. The greater the attenuation, the smaller the throughput energy and voltage.

BROADBAND HF/VHF/UHF COAXIAL PROTECTORS

APPLICATION:

For general radio use; bulkhead mountable for screen room/shielded penetration.
NOT where transmitter combining is performed.



Model shown **IS-B50LN-C2**, bulkhead mount

NOTE: See pages 12 & 13 for lightning frequency attenuation curve.

- **Employs UL497B listed gas tube**
- **50Ω models**
- **1.5MHz to 1000MHz** (over three models)
- **Works on all equipment unlike dc continuity protectors which can't protect receivers, shunt fed cavities, etc.**
- **Multi-strike capability**
- **Low strike throughput energy**
- **Bulkhead mount/ground** (flange mount adapter, page 44)
- **Housed use only**
- **Weatherize using WK-1,** page 51
- **Aluminum enclosure**
- **18-8 stainless steel hardware**
- **UHF nickel shell, silver center, TFE**
- **N silver shell and gold center pin**

NON-STOCKED OPTIONS: BNC, TNC, and SMA connectors, extra connector nut, EMI/RFI weather washer, unit specificic VSWR and I.L. plots.

MIL SPECS: Meets 6' all angle drop test, Op to 70,000', Mil-STD-202, 107F Cond. B -65°C to 125°C, Rainproof option meets many Mil specs under 202 and 810 for vibration, shock (both), fungus, etc. UHF & N connectors Mil-C-39012, QQ-S-365, QQ-B-626, QQ-C-530 and Mil-G-45204, follows Mil-STD-454J, Solder QQ-S-571 Sn62

PRODUCT DIMENSIONS: See page 64.

MAXIMUM CHARACTERISTICS

Surge:
50kA IEC 1000-4-5 8/20μs waveform 500 Joules

Turn-on:	Turn-on Time:
600Vdc ±20%	2.5ns for 2kV/ns L models
1200Vdc ±20%	7ns for 2kV/ns H models

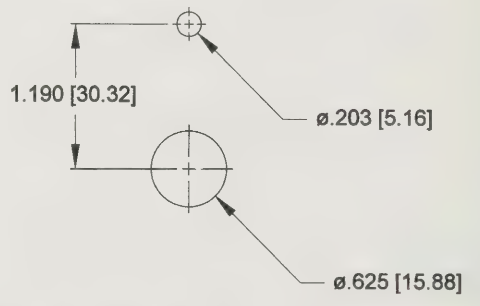
VSWR: (See plots page 10)
≤1.1 to 1 type N connectors
≤1.2 to 1 type UHF connectors

Insertion Loss:
≤0.1dB over frequency range

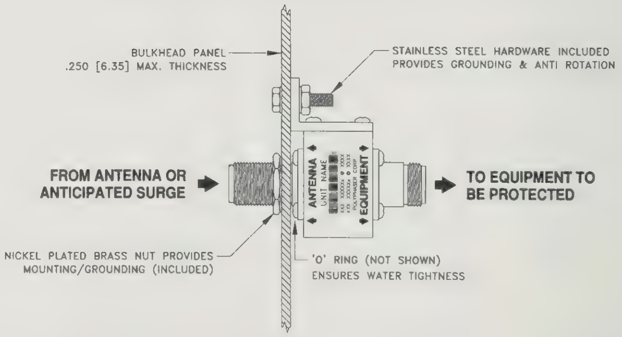
Temperature:
-55°C to +125°C Storage/Operating +50°C

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

MOUNTING HOLE PATTERN



TYPICAL MOUNTING CONFIGURATION



BROADBAND HF/VHF/UHF COAXIAL PROTECTORS

Order:

UHF CONNECTORS (Females Standard)

IS-B50LU-C0 ≤10mJ Throughput Energy
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

IS-B50HU-C0 ≤20mJ Throughput Energy
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 3kW, VHF 500W, UHF 250W

IS-B50LU-C1 ≤600μJ Throughput Energy
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 375W, UHF 125W

IS-B50HU-C1 ≤1mJ Throughput Energy
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 500W, UHF 250W

Choose lowest throughput energy for desired frequency. Energy based on 8/20μs waveform.

Add suffix: **-MA** for male connector on antenna port
-ME for male on equipment port
-MA/**ME** special order

Add $10.00 for each UHF male.

Note: *All transmit powers are single channel transmit. (Do not use on combiners.) See pages 24 through 28 for multi-channel transmit applications.*

See pages 12 and 13 for lightining spectrum attentu nation graphs.

N CONNECTORS (Females Standard)

IS-B50LN-C0 ≤10mJ Throughput Energy
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

IS-B50HN-C0 ≤20mJ Throughput Energy
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 3kW, VHF 500W, UHF 250W

IS-B50LN-C1 ≤600μJ Throughput Energy
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 375W, UHF 125W

IS-B50HN-C1 ≤1mJ Throughput Energy
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 500W, UHF 250W

IS-B50LN-C2 ≤220μJ Throughput Energy
Frequency Range: 125MHz to 1000MHz
Max. Power: VHF 375W, UHF (low) 125W
800MHz to 1GHz 50W

IS-B50HN-C2 ≤800μJ Throughput Energy
Frequency Range: 125MHz to 1000MHz
Max. Power: VHF 500W, UHF (low) 250W
800MHz to 1GHz 125W

Choose lowest throughput energy for desired frequency. Energy based on 8/20μs waveform.

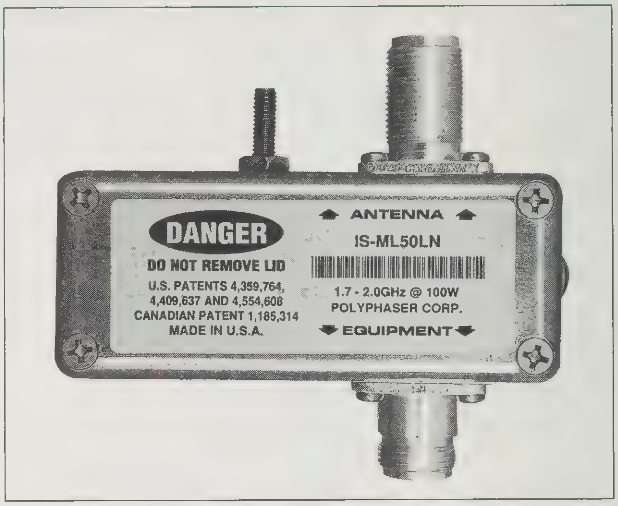
Add suffix: **-MA** for male connector on antenna port
-ME for male on equipment port
-MA/**ME** special order

Add $5.00 for each N male.

MICROWAVE COAXIAL PROTECTORS

APPLICATION:

Lightning/NEMP protection for any frequency range from 1GHz to 3GHz for point to point links transmit/receive and broadcast to 100W.



Model shown **IS-ML50LN**, bulkhead mount

- **50Ω models; 1GHz to 3GHz**
- **Works on all equipment unlike dc continuity protectors which can't protect receivers, shunt fed cavities, etc.** (For dc power via coax line see pages 20 & 21.)
- **Multi-strike capability**
- **Low strike throughput energy**
- **Bulkhead mounting/grounding** (flange mount adapter, page 44)
- **Housed use only**
- **Weatherize using WK-1,** page 51
- **18-8 stainless steel hardware**
- **N silver shell and gold center pin**

NON-STOCKED OPTIONS: BNC, SMA and TNC connectors, unit specific Return Loss or VSWR and Insertion Loss plots, Extra connector nut, EMI/RFI weather washer. For dc Path, see options available on page 21.

MIL SPECS: Many — call with requirements.

PRODUCT DIMENSIONS: See page 63.

MAXIMUM CHARACTERISTICS

Surge:
20kA IEC 1000-4-5 8/20μs waveform 138 Joules

Turn-on:
600Vdc ±20%

Turn-on Time:
2.5ns for 2kV/ns

VSWR:
≤1.1 to 1

Power:
100W

Insertion Loss:
≤0.1dB

Throughput Energy:
≤1μJ for 2kV/ns

NEMP Peak Throughput Voltage:
Typical 56Vp for 3/250ns waveform

Temperature:
-50°C to +105°C Storage/Operating +50°C

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

Order:

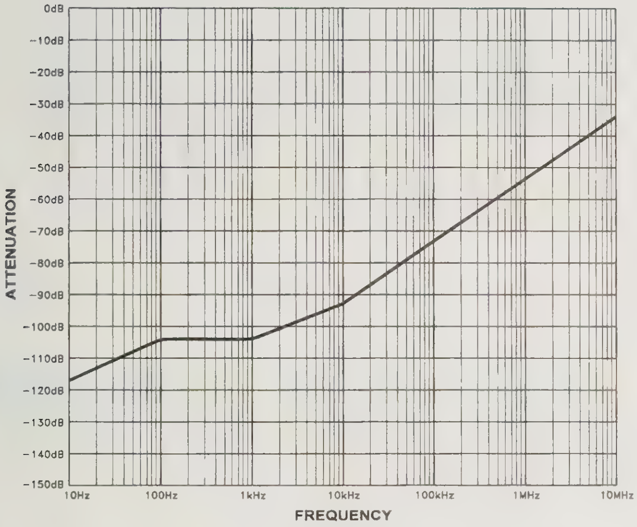
IS-MR50LN	for 980MHz to 1.8GHz GPS (Passive Antenna)
IS-ML50LN	for 1.7GHz to 2.0GHz Microwave Low 2GHz (PCS/PCN)
IS-MH50LN	for 2.0GHz to 2.3GHz Microwave Hi 2GHz
IS-MT50LN	for 2.1GHz to 2.6GHz Microwave TV for MMDS, wireless LAN's
IS-MU50LN	for 2.4GHz to 3.0GHz Microwave Upper

Add suffix to above models:
-MA for male N on antenna port
-ME for male N on equipment port
-MA/ME Not Available

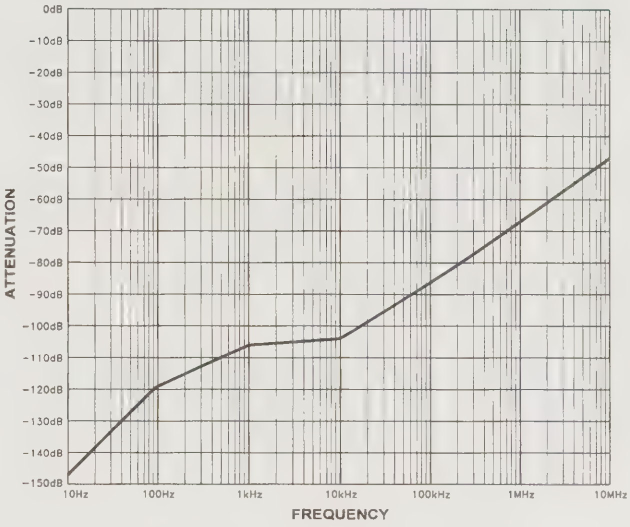
Add $5.00 for each N male.

LIGHTNING SPECTRUM ATTENUATION

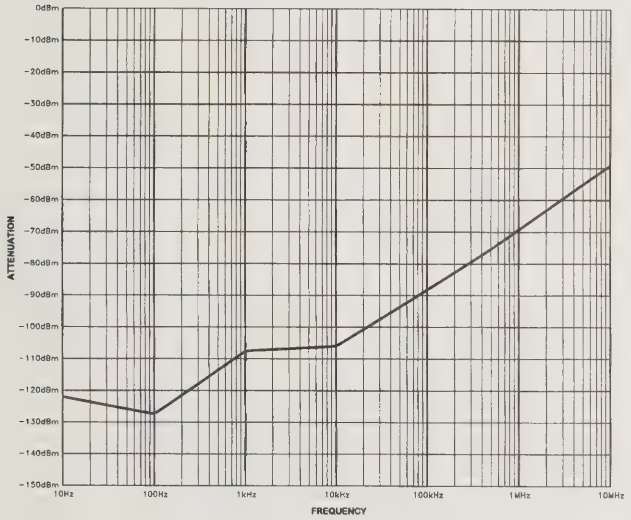
IS-MR50LN



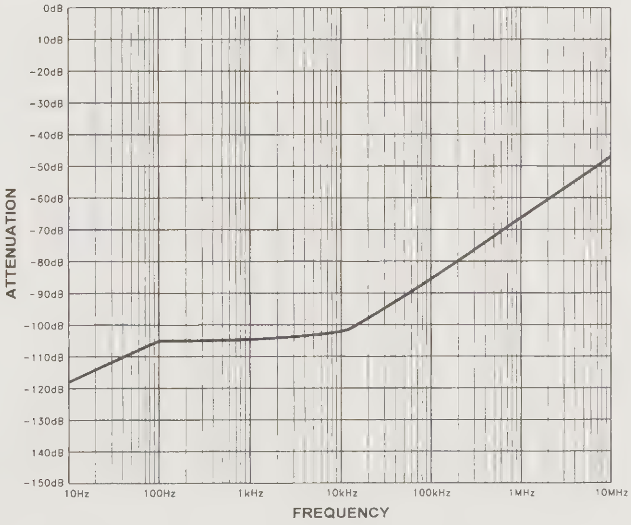
IS-ML50LN/IS-MH50LN



IS-MU50LN



IS-MT50LN



The throughput voltage to your equipment is related to the attenuation of the low frequency energy. The greater the attenuation, the smaller the throughput energy and voltage.

FILTERED AND GROUNDED COAXIAL PROTECTORS

APPLICATION:

GaAs FET receivers and low powered transmitters from 20MHz to 1GHz.

- **Four pole filter further attenuates strike energy**
- **Ultra-low throughput energy**
- **dc grounded on equipment port for less strike noise**
- **Wide bandwidths**
- **Multi-strike capability**
- **Bulkhead mounting/grounding** (flange mount adapter, page 44)
- **Housed use only**
- **Weatherize using WK-1,** page 51
- **Aluminum enclosure, 18-8 stainless steel hardware**
- **N silver shell and gold center pin**

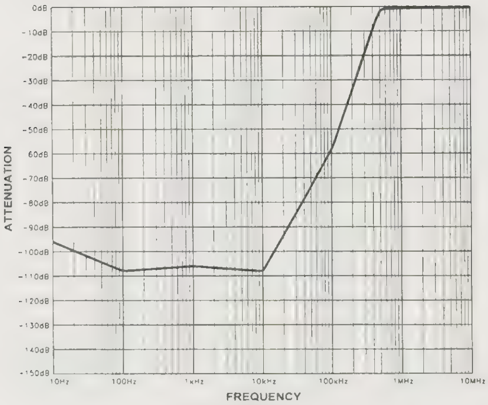
NON-STOCKED OPTIONS: BNC, SMA and TNC connectors, Extra connector nut, EMI/RFI washer, Lower frequency units available, unit specific VSWR and I.L. plots, other connectors.

MIL SPECS: Many — call will requirements.

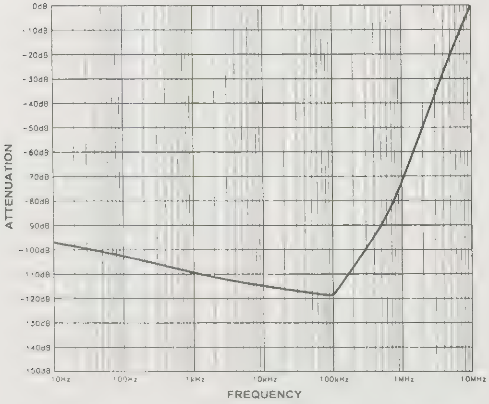
PRODUCT DIMENSIONS: See page 63.

LIGHTNING SPECTRUM ATTENUATION

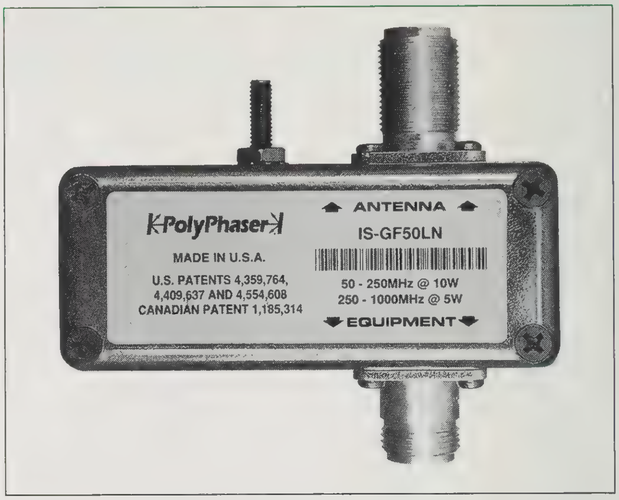
IS-LR50LN



IS-GF50LN



The throughput voltage to your equipment is related to the attenuation of the low frequency energy. The greater the attenuation, the smaller the throughput energy and voltage.



Model shown **IS-GF50LN**, bulkhead mount

MAXIMUM CHARACTERISTICS

Surge:
18kA IEC 1000-4-5 8/20μs waveform 110 Joules

Turn-on:
90V ±20%

Turn-on Time:
4ns for 2kV/ns

VSWR:
≤1.1 to 1 over frequency range

Insertion Loss:
≤0.1dB throughout most of the frequency range

Temperature:
-40°C to +85°C Storage/Operating +50°C

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

Order:

N CONNECTORS (Females Standard)

IS-LR50LN ≤700μJ Throughput Energy
Frequency Range: 20MHz to 300MHz
Max. Power: HF 25W, VHF 10W

IS-GF50LN ≤150pJ Throughput Energy
Frequency Range: 80MHz to 900MHz
(50MHz to 1GHz ≤1.2 to 1 VSWR)
Max. Power: VHF 10W, UHF 5W

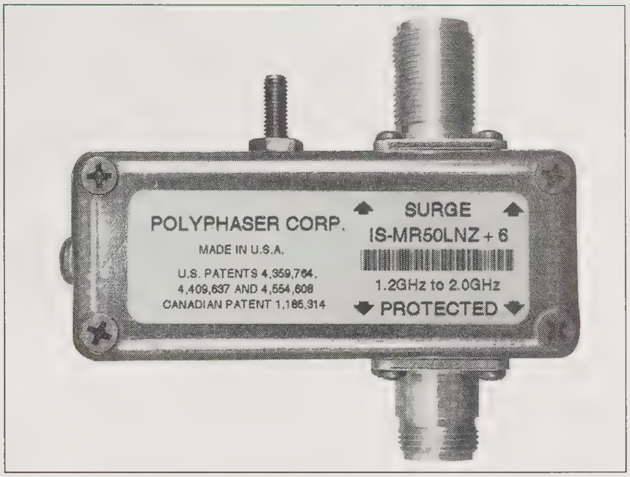
Choose lowest throughput energy for desired frequency. Energy based on 8/20μs waveform.

Add suffix:
-MA for male connector on antenna port
-ME for male on equipment port
-MA/ME special order
Add $5.00 for each N male.

GLOBAL POSITIONING SYSTEM COAXIAL PROTECTORS

APPLICATION:

Lightning protection for GPS receivers with active antennas



Model shown **IS-MR50LNZ+6**, bulkhead mount

- **50Ω models; 1.2GHz to 2.0GHz**
- **Protects in-line amplifiers and GPS receivers**
- **Provides positive and reverse voltage protection**
- **Low loss and low VSWR**
- **Multi-strike capability**
- **Low strike throughput energy**
- **Housed use only**
- **Weatherize using WK-1,** page 51
- **18-8 stainless steel hardware**
- **N silver shell and gold center pin**
- **Bulkhead mounting/grounding** (flange mount adapter, page 44)

NON-STOCKED OPTIONS: BNC, SMA and TNC connecters, unit specific return loss or VSWR and insertion loss plots; extra connector nut; EMI/RFI weather gasket; other connectors.

MIL SPECS: Many — call with requirements.

PRODUCT DIMENSIONS: See page 63.

Order:

IS-MR50LNZ+6 (N connectors only)
IS-MR50LNZ+15 (N connectors only)

Add suffix: **-MA** for male connector on antenna port
-ME for male connector on equipment port
-MA/ME Not available

Add $5.00 for each N male.

MAXIMUM CHARACTERISTICS

Surge:
20kA IEC 1000-4-5 8/20μs waveform

Turn-on:
+7, -1Vdc for IS-MR50LNZ+6
+17, -1Vdc for IS-MR50LNZ+15

Turn-on Time:
4ns for 2kV/ns

VSWR:
≤1.1 to 1 over frequency range

Insertion Loss:
≤0.1dB

Throughput Energy:
0.4μJ at 2kV/ns (3/250ns waveform)

User Current:
2.5Adc continuous

Frequency Range:
1.2GHz to 2.0GHz

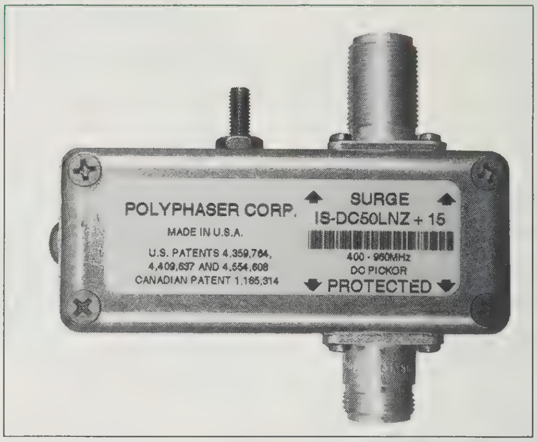
Temperature:
-50°C to +125°C Storage/Operating +60°C

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

DC INJECTOR/PICKOFF/PICKOR COAXIAL PROTECTORS

APPLICATION:

To supply or control remote equipment by injecting an ac or dc voltage onto the coax line and picking it off. A "pickor" is a contraction of pickoff and injector. It is transparent to supply voltages. It protects optimally by separating the supply voltage and the RF, protecting each, then re-injecting the supply voltage onto the coax. Ideal for bulkhead locations to prevent the surge from getting into the facility.



Model shown **IS-DC50LN+15,** bulkhead mount

- **Multi-stage patented design**
- **Multi-strike capability**
- **Low throughput energy**
- **Receive only (Transmit units available)**
- **Bulkhead mounting/grounding** (flange mount adapter, page 44)
- **Housed use only**
- **Weatherize using WK-1,** page 51
- **Aluminum enclosure**
- **18-8 stainless steel hardware**
- **N silver shell and gold center pin**

NON-STOCKED OPTIONS: BNC, SMA and TNC connectors, Extra connector nut, -60Vdc and ac voltages, Higher user currents, Other frequencies ranging from 1.5MHz to 20GHz, Transmit and combiner capabilities to 1kW at some frequency ranges, Other impedances/connectors, unit specific VSWR and I.L. plots.

MIL SPECS: Many — call with requirements.

PRODUCT DIMENSIONS: See page 63.

MAXIMUM CHARACTERISTICS

Surge:
18kA IEC 1000-4-5 8/20μs waveform 110 Joules

Turn-on:
≈15% above model voltage

Turn-on Time:
<4ns for 2kV/ns

Let-Through dc Port:
Contact factory with model number.

Frequency Range:
400MHz to 960MHz

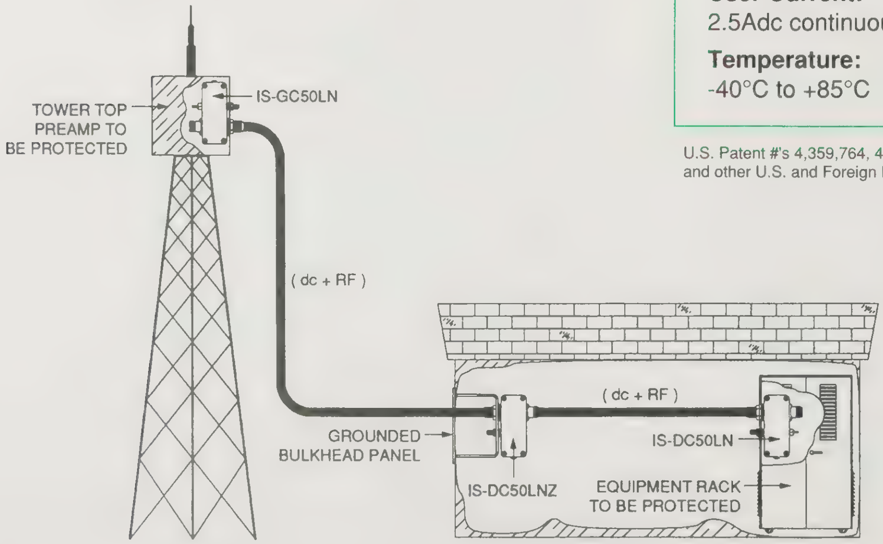
VSWR:
≤1.2 to 1 over the frequency range

Insertion Loss:
≤0.3dB over the frequency range

User Current:
2.5Adc continuous

Temperature:
-40°C to +85°C Storage/Operating +50°C

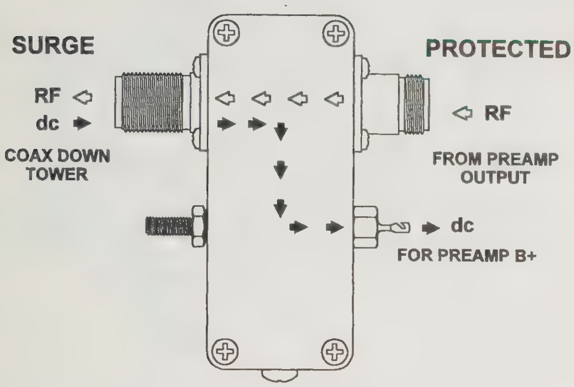
U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.



TYPICAL APPLICATION

DC INJECTOR/PICKOFF/PICKOR COAXIAL PROTECTORS

dc PICKOFF



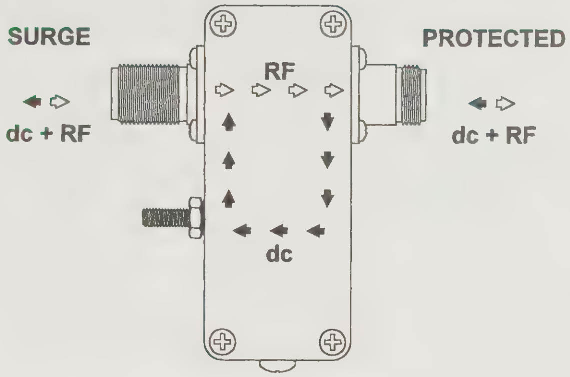
PICK OFF dc BUT OPTIMIZED FOR OPPOSITE RF PASSAGE

Order: **IS-GC50LN+(15,20,26,30,36)** Pickoff

Add suffix: **-MA** for male connector bulkhead port
-ME for male opposite bulkhead port
-MA/ME special order

Add $5.00 for each N male.

dc PICKOR



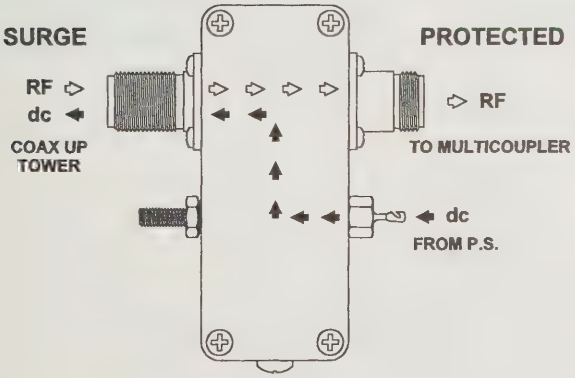
PICK OFF dc AND RE-INJECTS FOR OPTIMAL PROTECTION FOR BULKHEAD PANEL USERS

Order: **IS-DC50LNZ+(15,20,26,30,36)** Pickor

Add suffix: **-MA** for male connector bulkhead port
-ME for male opposite bulkhead port
-MA/ME special order

Add $5.00 for each N male.

dc INJECTOR



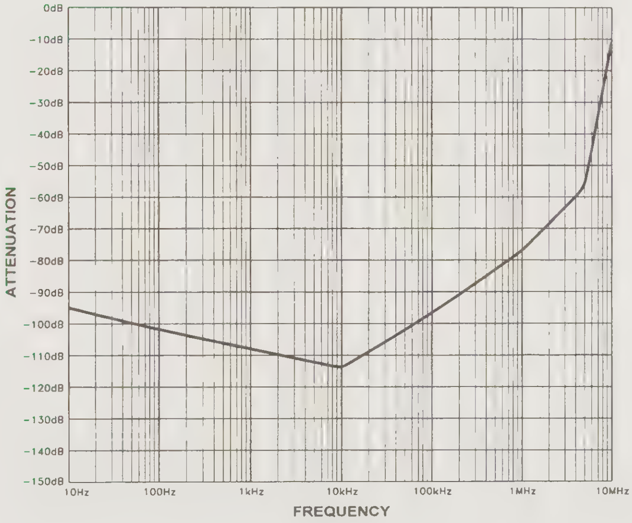
INJECTS dc ONTO THE COAX

Order: **IS-DC50LN+(15,20,26,30,36)** Injector

Add suffix: **-MA** for male connector bulkhead port
-ME for male opposite bulkhead port
-MA/ME special order

Add $5.00 for each N male.

IS-DC50LN / IS-GC50LN
LIGHTNING SPECTRUM ATTENUATION



The throughput voltage to your equipment is related to the attenuation of the low frequency energy. The greater the attenuation, the smaller the throughput energy and voltage.

DC PATH-MW DOWNCONVERTED COAXIAL PROTECTORS

APPLICATION:

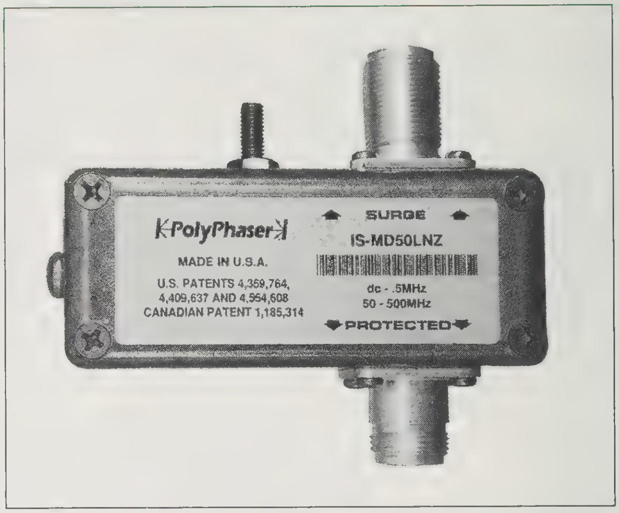
18GHz and up Microwave Systems that use Gunnplexers and have 50 to 500MHz IF frequencies with power and/or data or error signals in the dc to 0.5MHz band. Two are required for complete protection - one inside the tower top unit and one inside the hut at the bulkhead panel.

- **Employs UL497B listed gas tube**
- **Transceive bi-directional to signals**
- **Handles and protects standard telco battery power on coax**
- **Patented design separates the dc from the RF, protects each optimally and recombines them**
- **Bulkhead mounting/grounding** (flange mount adapter, page 44)
- **Lower throughput energy than dc continuity protectors** (dc type protectors with a gas tube will not handle the voltage and current for this application without the tube staying on and destroying itself with the first strike)
- **Weatherize using WK-1,** page 51
- **Multi-strike capability**
- **NEMP rated**
- **Aluminum enclosure**
- **Housed use only**
- **18-8 stainless steel hardware**
- **N silver shell and gold center pin**

NON-STOCKED OPTIONS: BNC, SMA and TNC connectors, Extra connector nut, EMI/RFI weather gasket, Other voltages available below 60Vdc and ac, unit specific VSWR and I.L. plots, larger dc bandwidths available.

MIL SPECS: Many — call with requirements.

PRODUCT DIMENSIONS: See page 63


PolyPhaser
MADE IN U.S.A.
U.S. PATENTS 4,359,764, 4,409,637 AND 4,554,608
CANADIAN PATENT 1,185,314
SURGE
IS-MD50LNZ
dc - .5MHz
50 - 500MHz
PROTECTED

Model shown **IS-MD50LNZ**, bulkhead mount

MAXIMUM CHARACTERISTICS

Surge:
20kA IEC 1000-4-5 8/20μs waveform 138 Joules

Turn-on:
-66Vdc, 2Vdc ±10%

Turn-on Time:
4ns for 2kV/ns

VSWR:
≤1.2 to 1 over frequency range

Insertion Loss:
≤0.3dB

Throughput Energy:
10μJ for 1kV/ns

Usage Current:
2.5Adc continuous

Frequency Range:
dc to 0.5MHz and 50MHz to 500MHz

Temperature:
-40°C to +85°C Storage/Operating +50°C

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

Order:

IS-MD50LNZ (N connectors only)

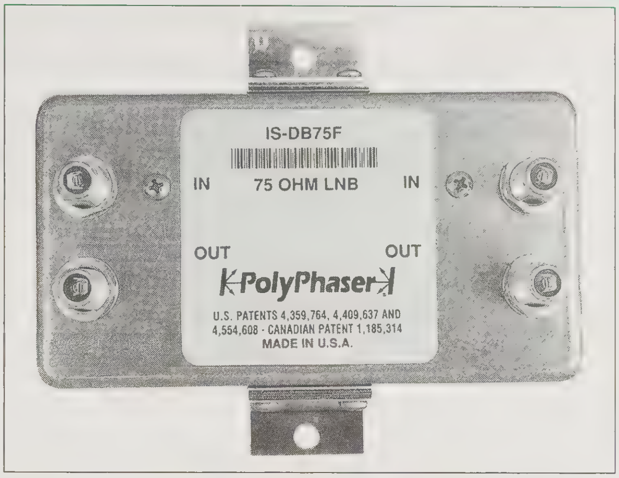
Add suffix: **-MA** for male N on antenna port
-ME for male equipment port
-MA/ME special order

Add $5.00 for each N male.

BROADBAND DC PATH 75 OHM COAXIAL PROTECTOR

APPLICATION:

Satellite dish receivers where the LNB(s) is powered via the coax line from the receiver. Simplex RF LAN operation with switched antenna preamp.


IS-DB75F
IN
75 OHM LNB
IN
OUT
OUT
PolyPhaser
U.S. PATENTS 4,359,764, 4,409,637 AND 4,554,608 - CANADIAN PATENT 1,185,314
MADE IN U.S.A.

Model shown **IS-DB75F**, flange mount

- **Single and dual LNB models**
- **Two-stage patented design**
- **Multi-strike capability**
- **Housed use only - Mounts into IS-TVRO** (see page 29.)
- **Aluminum enclosure**
- **18-8 stainless steel hardware**
- **Weatherize using WK-1,** page 51

NON-STOCKED OPTIONS:
Other dc voltages 6V, 17V, 30V available, 70Ω type N female connectors available.

MIL SPECS: Many — call with requirements.

PRODUCT DIMENSIONS: See page 68.

MAXIMUM CHARACTERISTICS

Surge:
18kA IEC 1000-4-5 8/20μs waveform 110 Joules

Turn-on:
26Vdc, -1Vdc ±5%

Turn-on Time:
6ns for 2kV/ns

VSWR:
IS-SB75F 1.2 to 1 over the frequency range
IS-DB75F 1.5 to 1 over the frequency range

Insertion Loss:
≤0.3dB over the frequency range

Frequency Range:
450MHz to 1450MHz

Temperature:
-25°C to +85°C Storage/Operating +50°C

Order:

IS-SB75F	for single protector (F females standard)
IS-DB75F	for dual protector (F females standard)

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

VHF/UHF CROSS BAND COMBINER COAXIAL PROTECTORS

APPLICATION:

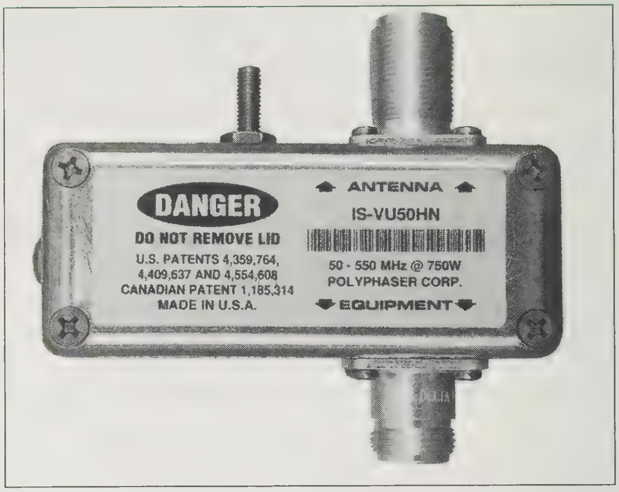
Where multi-band transmit channels are combined to save transmission line expense and then re-separated for individual band antennas.

- **High number of combined channels handled**
- **High turn-on for clean peak voltage handling**
- **High channel power handling**
- **dc blocked design**
- **Low throughput energy**
- **Multi-strike capability**
- **Bulkhead mounting/grounding** (flange mount adapter, page 44)
- **Housed use only**
- **Weatherize using WK-1,** page 51
- **Aluminum enclosure**
- **18-8 stainless steel hardware**
- **N silver shell and gold center pin**

NON-STOCKED OPTIONS: BNC, SMA and TNC connectors, extra connector nut, EMI/RFI weather washer, unit specific VSWR and I.L. plots.

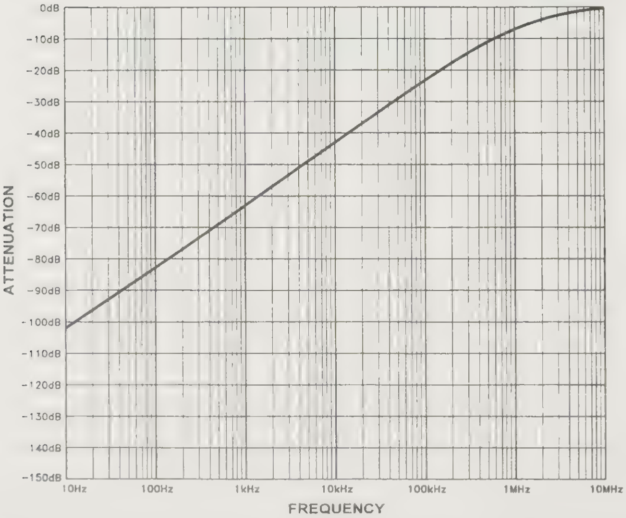
MIL SPECS: Many — call with requirements.

PRODUCT DIMENSIONS: See page 63.



Model shown **IS-VU50HN**, bulkhead mount

IS-VU50HN / IS-CU50HN
LIGHTNING SPECTRUM ATTENUATION



The throughput voltage to your equipment is related to the attenuation of the low frequency energy. The greater the attenuation, the smaller the throughput energy and voltage.

MAXIMUM CHARACTERISTICS

Surge:
50kA IEC 1000-4-5 8/20µs waveform 500 Joules

Turn-on:
1800Vdc Vt= 1200V IS-VU50HN
1200Vdc Vt= 1200V IS-CU50HN

Turn-on Time:
15ns IS-VU50HN
7ns IS-CU50HN

VSWR:
≤1.1 to 1 over frequency range

Insertion Loss:
≤0.1dB over frequency range

Temperature:
-25°C to +50°C Storage/Operating

Order:
V=150MHz band, U=450MHz band, C=800/900MHz

IS-VU50HN ≤7mJ throughput energy 8/20µs waveform
Frequency Range: 50MHz to 550MHz
Max. Power: 750W single channel
See formula for multi-channel page 62.

IS-CU50HN ≤5mJ throughput energy 8/20µs waveform
Frequency Range: 450MHz to 900MHz
Max. Power: 250W single channel
See formula for multi-channel page 62.

N female connectors standard both models

Add suffix: **-MA** for male on antenna port
-ME for male on equipment port
-MA/ME special order
Add $5.00 for each N male.

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

UHF COMBINER COAXIAL PROTECTOR

APPLICATION:

For the UHF 380MHz to 512MHz bands where multi-transmitters are combined, excellent receive only protector.

- **Employs UL497B listed gas tube**
- **Multi-strike capability**
- **Unique dc blocked air strip line design**
- **Very low throughput energy**
- **High number and power of combined channels handled** (see page 62 for formula) **750W single channel**
- **Works on all equipment unlike dc continuity protectors which can't protect receivers and shunt fed cavities, etc.**
- **Housed use only**
- **Weatherize usingWK-1,** page 51
- **Aluminum enclosure**
- **18-8 stainless steel hardware**
- **N silver shell and gold center pin**
- **Flange mount** (bulkhead mount, page 66)

NON-STOCKED OPTIONS: Extra connector nut, UHF connectors, unit specific VSWR and I.L. plots and sampler ports.

MIL SPECS: Many — call with requirements.

PRODUCT DIMENSIONS: See page 66.

MAXIMUM CHARACTERISTICS

Surge:
20kA IEC 1000-4-5 8/20μs waveform 130 Joules

Turn-on:
1200 Vdc Vt= 1200V

Turn-on Time:
7ns for 2kV/ns

VSWR:
≤1.1 to 1 over frequency range

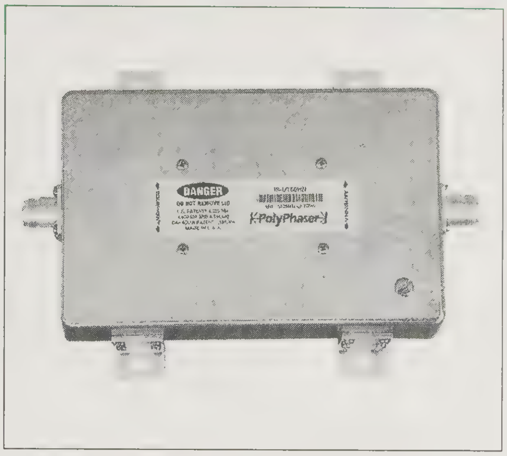
Insertion Loss:
≤0.1dB over frequency range

Throughput Energy:
10μJ for 8/20μs waveform

Temperature:
-25°C to +50°C Storage/Operating +50°C

Max. Power:
750W single channel
(See formula for multi-channel page 62.)

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.



Model shown **IS-UT50HN**, flange mount

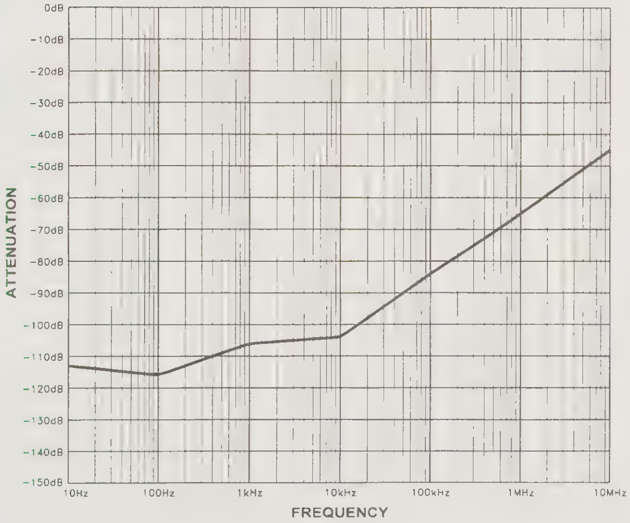
Order:

IS-TT50HN for 380 to 450MHz with flange mount
IS-TT50HN-B for 380 to 450MHz with bulkhead mount
IS-UT50HN for 450 to 512MHz with flange mount
IS-UT50HN-B for 450 to 512MHz with bulkhead mount
IS-ST50HN for 340 to 380MHz with flange mount
IS-ST50HN-B for 340 to 380MHz with bulkhead mount

Add suffix: **-MA** for male connector antenna port
-ME for male equipment port
-MA/ME special order

Add $5.00 for each N male.

**IS-UT50HN
LIGHTNING SPECTRUM ATTENUATION**



The throughput voltage to your equipment is related to the attenuation of the low frequency energy. The greater the attenuation, the smaller the throughput energy and voltage.

SAMPLER PORT CELLULAR/PAGING COMBINER COAXIAL PROTECTOR

Sampler Port Information

PolyPhaser developed the Sampler Port Series to eliminate the sharing of center pin surge current common to 1/4 wave stubs and other dc continuity protectors. The patented PolyPhaser protectors have center pin dc blocking and have as much as 60dB more attenuation of lightning frequencies than 1/4 wave devices.

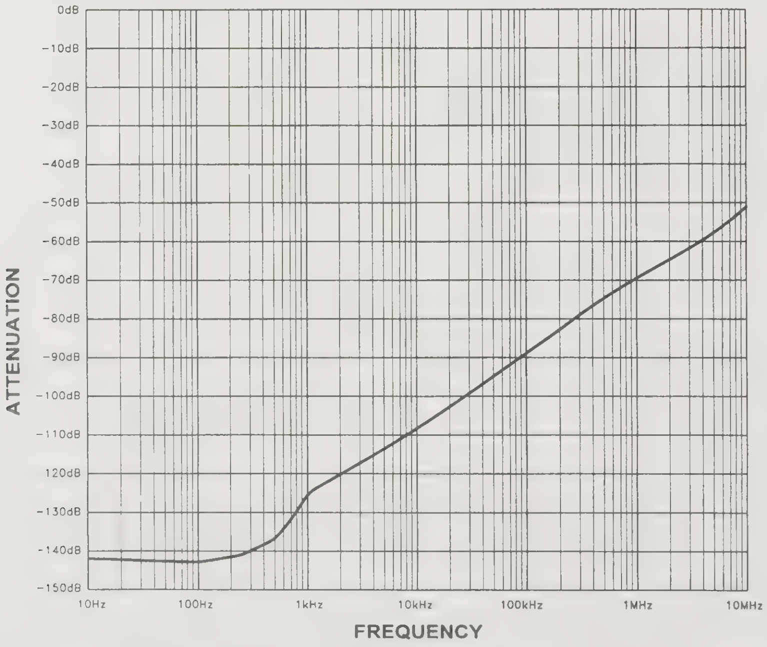
A number of protectors are sold on the premise of reducing the number of connectors needed in the cable system. Consider, however, the problems associated with this concept. At some time it will become necessary to sweep or TDR test your cable or antenna. This can not be accomplished with a 1/4 wave filter in line. An RF sweep will be colored by the 1/4 wave and will not show the true frequency versus return loss (or VSWR). A TDR pulse will not pass through the 1/4 wave.

With PolyPhaser's Sampler Port Series, preventative maintenance and troubleshooting can be easily accomplished without removing the protectors. The Sampler Port with its BNC connector dc connects to the antenna line permitting the port to be used for "on-air" relative spectrum analysis (signal strength at discrete frequencies can be noted for future comparisons), time domain reflectometry (TDR), testing for VSWR, power monitoring, RF sweeps, and protector testing.

The port is buffered by a parallel tuned circuit which provides a minimum of 20dB (typically 30dB) attenuation of the transmit signals. The inductance will show on a low resolution TDR response as a small discontinuity but the location will be obvious.

For a 2ns TDR pulse, the total pulse loss is -3dB, round trip. A future PolyPhaser product will use the port to count lightning strikes and to determine the severity of the hit. This information may be transmitted back to central dispatch for a decision as to whether a site visit is necessary. To provide the best service, you need the best preventative maintenance. It is not economical to perform a PM without knowing what to look for at the site. Additionally, the sampler port may be used to determine if a strike in the area is likely. This will mean that someone can visit the site an hour before and check the generator fuel or switch a problem site off-line until the storm passes.

IS-CS50HN
Lightning Spectrum Attenuation



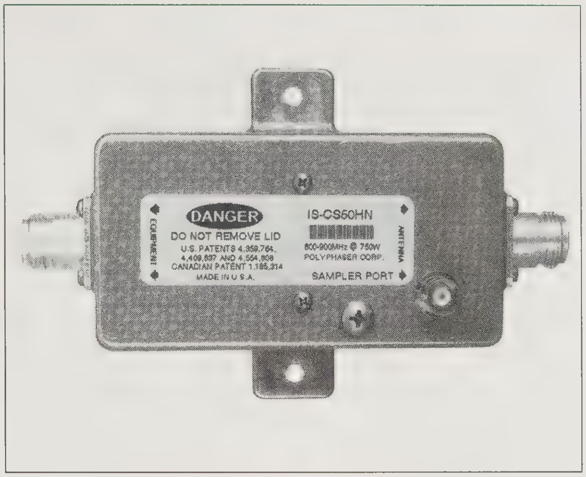
The throughput voltage to your equipment is related to the attenuation to the low frequency energy. The greater the attenuation, the smaller the throughput energy and voltage.

SAMPLER PORT CELLULAR/PAGING COMBINER COAXIAL PROTECTOR

APPLICATION:

Designed for 800 to 980MHz bands with multi-channel or combined transmitters. Sampler Port provides access for on-air testing of cables without removing the protector.

- **Employs UL497B listed gas tube**
- **Built-in sampler port features BNC connector**
- **Ideal for combined transmit/receive applications**
- **Multi-strike capability**
- **EMP rated protectors**
- **Sampler port is coupled to the antenna port**
- **Works on all equipment unlike dc continuity protectors which can not protect receivers and shunt fed cavities, etc.**
- **Flange mounting/grounding** (bulkhead mount adapter, page 44)
- **Housed use only**
- **Weatherize using two WK-1,** page 51
- **Aluminum enclosure**
- **18-8 stainless steel hardware**



Model shown **IS-CS50HN**, flange mount

NON-STOCKED OPTIONS: BNC, SMA and TNC connectors, extra N connector nut, dc injection/pickoff/pickor (see page 20); 7/8" center bullets, LC connectors, unit specific VSWR and I.L. plots.

MIL SPECS: Many — call with requirements.

PRODUCT DIMENSIONS: See page 66.

MAXIMUM CHARACTERISTICS

Surge:
20kA IEC 1000-4-5 8/20µs waveform 138 Joules

Turn-on:
1200Vdc Vt: 1800V

Turn-on Time:
7.0ns for 2kV/ns

VSWR:
≤1.1 to 1 over frequency range

Insertion Loss:
≤0.1dB over frequency range

Throughput Energy:
10µJ for 8/20µs waveform

Max. Power:
750W single channel
(See formula for multi-channel page 62.)

Temperature:
-25°C to +50°C Storage/Operating

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314
and other U.S. and Foreign Patents Pending.

Order:

IS-CS50HN
for 800 to 900MHz, type N females, flange mount
IS-CS50HN-B
for 800 to 900MHz, type N females, bulkhead mount
IS-CS50HD
for 800 to 900MHz, type DIN 7/16, flange mount
IS-CS50HD-B
for 800 to 900MHz, type DIN 7/16, bulkhead mount
IS-CS50HLC
for 800 to 900MHz, type LC females, flange mount
IS-CS50H78E
for 800 to 900MHz, flange type 7/8" EIA (sex less)
IS-PS50HN
for 890 to 980MHz, type N females, flange mount
IS-PS50HN-B
for 890 to 980MHz, type N females, bulkhead mount
IS-PS50HD
for 890 to 980MHz, type DIN 7/16, flange mount
IS-PS50HD-B
for 890 to 980MHz, type DIN 7/16, bulkhead mount

Add suffix: **-MA** for male antenna port
-ME for male equipment port
-MA/ME special order

Add $5.00 for each N male.

Add $20.00 for each DIN male.

CELLULAR/PAGING COMBINER COAXIAL PROTECTOR

APPLICATION:

For the 800 to 980MHz bands where multi-transmitters are combined, excellent receive only protector, Broadcast STL links.

- Employs UL497B listed gas tube
- Multi-strike capability
- Unique dc blocked air strip line design
- Very low throughput energy
- High number and power of combined channels handled (See page 62 for formula.) 750W single channel
- Works on all equipment unlike dc continuity protectors which can't protect receivers and shunt fed cavities, etc.
- Bulkhead mounting/grounding to 1/4" panels for type N connectors
- Housed use only - aluminum enclosure
- Weatherize using WK-1, page 51
- 18-8 stainless steel hardware
- N silver shell and gold center pin
- LC silver shell with silver center pin

NON-STOCKED OPTIONS: BNC, SMA and TNC connectors, extra N connector nut, dc injection/pickoff/pickor see page 20, 7/8" center bullets, LC connectors, unit specific VSWR and IL plots.

MIL SPECS: Many — call with requirements.

PRODUCT DIMENSIONS: See page 65.

The throughput voltage to your equipment is related to the attenuation of the low frequency energy. The greater the attenuation, the smaller the throughput energy and voltage.

MAXIMUM CHARACTERISTICS

Surge:
20kA IEC 1000-4-5 8/20µs waveform 138 Joules

Turn-on:
1200Vdc   Vt= 1800V

Turn-on Time:
7.0ns for 2kV/ns

VSWR:
≤1.1 to 1 over frequency range

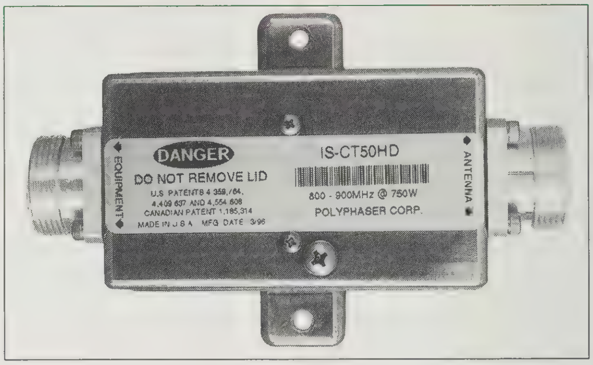
Insertion Loss:
≤0.1dB over frequency range

Throughput Energy:
10µJ for 8/20µs waveform

Max. Power:
750W single channel
(See formula for multi-channel page 62.)

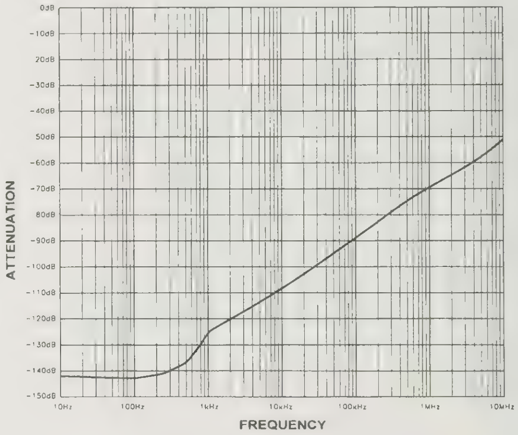
Temperature:
-25°C to +50°C Storage/Operating

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.



Model shown **IS-CT50HD**, flange mount

IS-CT50HN
LIGHTNING SPECTRUM ATTENUATION



Order:

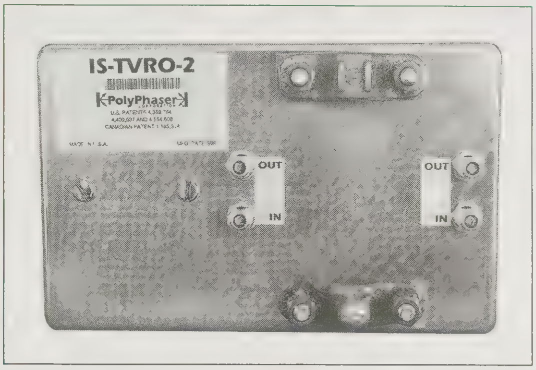
IS-CT50HN
for 800 to 900MHz, type N females, flange mount
IS-CT50HN-B
for 800 to 900MHz, type N females, bulkhead mount
IS-CT50HD
for 800 to 900MHz, type DIN 7/16, flange mount
IS-CT50HD-B
for 800 to 900MHz, type DIN 7/16, bulkhead mount
IS-CT50HLC
for 800 to 900MHz, type LC females, flange mount
IS-CT50H78E
for 800 to 900MHz, flange type 7/8" EIA (sexless)
IS-PT50HN
for 890 to 980MHz, type N females, flange mount
IS-PT50HN-B
for 890 to 980MHz, type N females, bulkhead mount
IS-PT50HD
for 890 to 980MHz, type DIN 7/16, flange mount
IS-PT50HD-B
for 890 to 980MHz, type DIN 7/16, bulkhead mount

Add suffix: **-MA** for male antenna port
-ME for male equipment port
-MA/ME special order

Add $5.00 for each N male.
Add $20.00 for each DIN male.

SATELLITE RECEIVER/LNB AND MOTOR CONTROL PROTECTORS

- Employs UL497B listed gas tube
- Single and dual LNBs
- Polarizing motor protection
- Three installation locations:
  - Outside at dish (mounts on ground rod)
  - Outside at cable entrance
  - Indoors at receiver
- Power line protection for indoor location
- Actuator cable protection module - optional (drop-in)
- Weatherize using two WK-1's, page 51
- Modular all-aluminum construction
- 18-8 stainless steel hardware



Model shown **IS-TVRO-2**

PRODUCT DIMENSIONS: See page 69.

Model shown **IS-PLTVRO-2P**

MAXIMUM CHARACTERISTICS

RF: (additional info, page 23)
- 450 to 1450MHz
- 1.2 to 1 Typical VSWR
- <0.5dB IL 0.3dB Typical
- Type F-59 connectors
- 2 Stage Patented Protection
- +26Vdc to -1Vdc Turn-on 13kA

Polarizing Motor:
Two Stages, 3 wires in and 3 wires out:
±24Vdc at 5A, 3kA surge each

Actuator:
Optional - Two Stages, 6 wires in and 6 wires out:
Motor lines ±36Vdc at 10A, 20kA surge each
Supply line ±15Vdc, 2.5kA surge
Pulse line ±15Vdc, 2kA surge
Protected static ground 18kA surge
Chassis ground or earth ground

Power Line:
In-line protector 15A, EMI/RFI filtering, 20kA surge

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

Order: For The Dish: (outdoor use)

IS-TVRO-P One LNB, Polar Motor
IS-TVRO-2 Two LNB's, No Polar Motor
IS-TVRO-2P Two LNB's Polar Motor

Option: **IS-AM36V** Drop-in Actuator module fits any above.

Order: For The IRD: (indoor use)

IS-PLTVRO-P Power line protector plus IS-TVRO-P
IS-PLTVRO-2 Power line protector plus IS-TVRO-2
IS-PLTVRO-2P Power line protector plus IS-TVRO-2P

Option: **IS-AM36V** Drop-in Actuator module fits any above.

PART 7 rf coupled shield/dc blocked

ISOLATED EQUIPMENT PORT COAXIAL PROTECTORS

APPLICATION:

Where the best protection is a must. This most unique PolyPhaser® is one that not only has a dc block for the center conductor but also blocks the shield's surge energy from going to your equipment chassis. This is the ultimate in protection and prevents ground loops for proper single point grounding.

Model shown **IS-IE50LN-C2**, bulkhead mount

- **RF coupled shield with >2kVdc breakdown**
- **Large bandwidths**
- **Transceive but not for combiner output**
- **Works on all equipment unlike dc continuity protectors which can't protect receivers and shunt fed cavities, etc.**
- **Bulkhead mounting/grounding** (flange mount adapter, page 44)
- **Multi-strike capability**
- **Low throughput energy**
- **Housed use only - aluminum enclosure**
- **Weatherize using WK-1,** page 51
- **18-8 stainless steel hardware**
- **N silver shell and gold center pin**

NON-STOCKED OPTIONS: Extra connector nut, EMI/RFI weather washer, Other frequency ranges, Higher power levels, unit specific VSWR and I.L. plots.

MIL SPECS: Many—call with requirements.

PRODUCT DIMENSIONS: See page 65.

MAXIMUM CHARACTERISTICS

Surge:
50kA IEC 1000-4-5 8/20μs waveform 500 Joules
20kA for IE-ML series

Turn-on:
600Vdc ±20% L models
1200Vdc ±20% H models

Turn-on Time:
2.5ns L; 7ns H; for 2kV/ns

VSWR:
≤1.1 to 1 over frequency range

Insertion Loss:
≤0.1dB over frequency range

Temperature:
-50°C to 125°C Storage/Operating +50°C

U.S. Patent #'s 4,359,764, 4,409,637, 4,554,608 Canadian Patent # 1,185,314 and other U.S. and Foreign Patents Pending.

ISOLATED EQUIPMENT PORT COAXIAL PROTECTORS

Order:

UHF CONNECTORS (Females Standard)

IS-IE50LU-C0 ≤10mJ Throughput Energy
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

IS-IE50HU-C0 ≤20mJ Throughput Energy
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 3kW, VHF 500W, UHF 250W

IS-IE50LU-C1 ≤600µJ Throughput Energy
Frequency Range: 50MHz to 500MHz
Max. Power: VHF 375W, UHF 125W

IS-IE50HU-C1 ≤1mJ Throughput Energy
Frequency Range: 50MHz to 500MHz
Max. Power: VHF 500W, UHF 250W

Choose lowest throughput energy for desired frequency.
Energy based on 8/20µs waveform.

Add suffix: **-MA** for male connector on antenna port
Add $10.00 for each UHF male.

N CONNECTORS (Females Standard)

IS-IE50LN-C0 ≤10mJ Throughput Energy
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

IS-IE50HN-C0 ≤20mJ Throughput Energy
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 3kW, VHF 500W, UHF 250W

IS-IE50LN-C1 ≤600µJ Throughput Energy
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 375W, UHF 125W

IS-IE50HN-C1 ≤1mJ Throughput Energy
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 500W, UHF 250W

IS-IE50LN-C2 ≤220µJ Throughput Energy
Frequency Range: 125MHz to 1000MHz
Max. Power: VHF 375W, UHF (low) 125W
800MHz to 1GHz 50W

IS-IE50HN-C2 ≤800µJ Throughput Energy
Frequency Range: 125MHz to 1000MHz
Max. Power: VHF 500W, UHF (low) 250W
800MHz to 1GHz 125W

IS-IEML50LN ≤1µJ Throughput Energy
Frequency Range: 1.7GHz to 2.0GHz
Max. Power: 100W

IS-IEMH50LN ≤1µJ Throughput Energy
Frequency Range: 2.0GHz to 2.3GHz
Max. Power: 100W

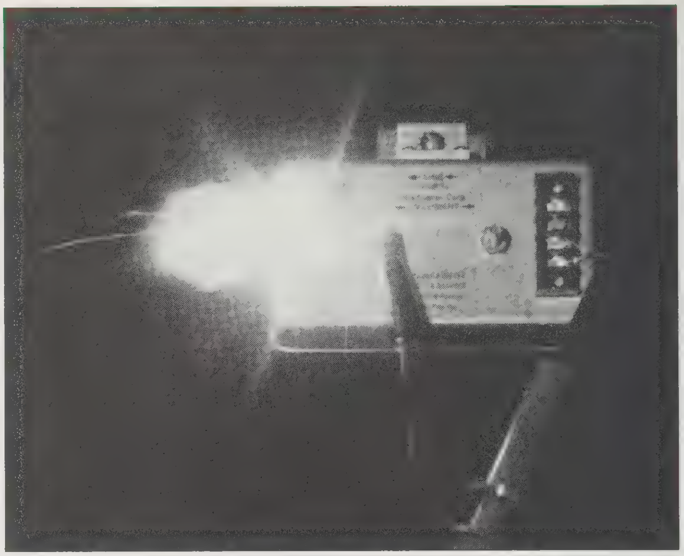
Choose lowest throughput energy for desired frequency.
Energy based on 8/20µs waveform.

Add suffix: **-MA** for male connector on antenna port
Add $5.00 for each N male.

IN-LINE TWISTED PAIR PROTECTORS

APPLICATION:

From T1, data, current loop for measurement and control, extension lines, telephone trunk lines to high speed data: Single, Double and Six Pair Protectors that can handle surges up to 36 to 40kA which can vaporize 24AWG wire without having damaging let-through voltages.



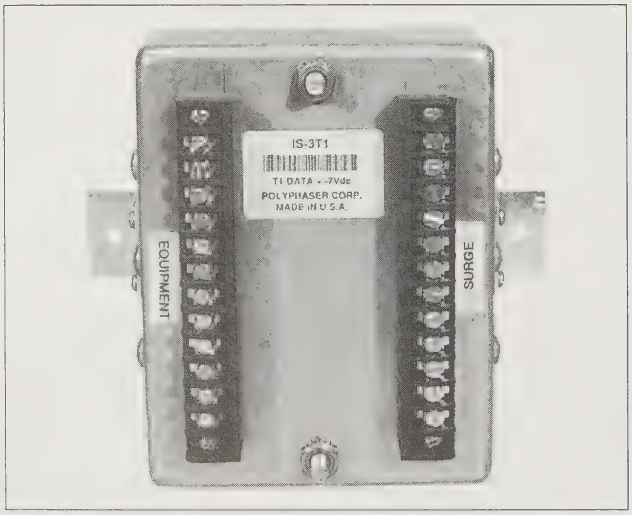
- Multi-stage protectors
- Large data bandwidths
- Low resistance on current loops
- Fast response times: <2ns, EMP rated
- Low let-through voltages
- Shielded fire proof enclosure
- Easy - positive floating plate screw connections
- Convenient ground stud for cable shield grounding
- Single and Dual pair mounts on IS-MSRP panel (see page 37)
- Flange mounting/grounding
- Housed use only
- 18-8 stainless steel hardware
- Temperature: -40°C to +85°C Storage/Operating +50°C
- T1: -12dB minimum common mode attenuation of EMP pulse

NON-STOCKED OPTIONS: Other voltages, Mil screen room penetration, can be made to meet many 202 or 810 specs, higher ring voltages, T1 models to handle dc power for repeaters.

MIL SPECS: Many — call with requirements.

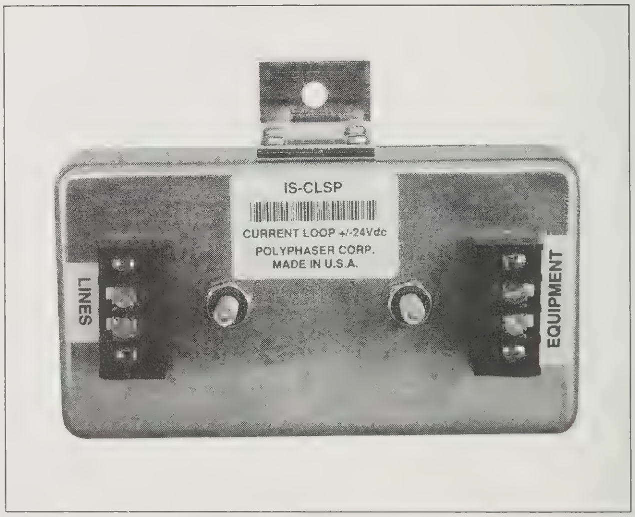
PRODUCT DIMENSIONS: See page 67.

T1 Data



Model Shown **IS-3T1**, flange mount

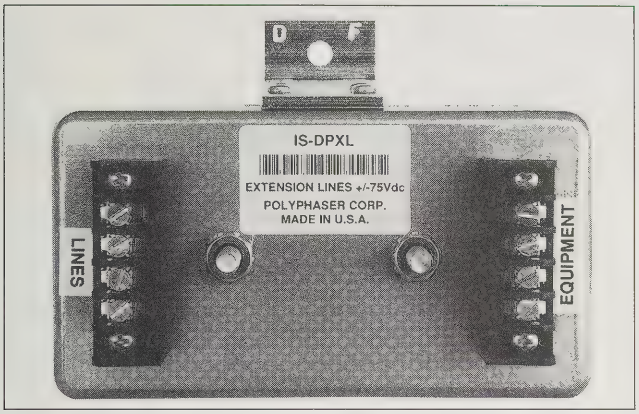
Current Loops



Model Shown **IS-CLSP**, flange mount

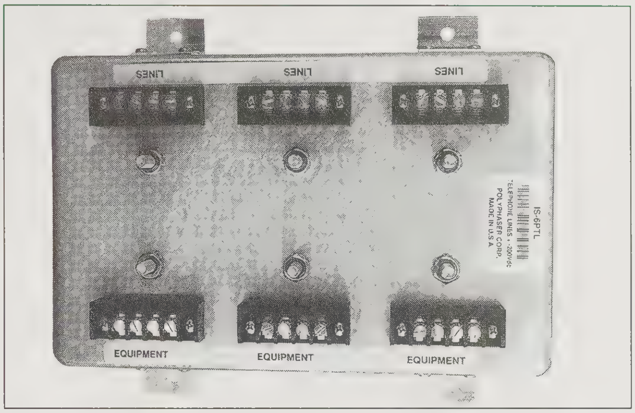
IN-LINE TWISTED PAIR PROTECTORS

Extension Lines



Model Shown **IS-DPXL**, flange mount

Telco Trunks



Model Shown **IS-6PTL**, flange mount

MAXIMUM CHARACTERISTICS

Typical Application:	Surge:	Turn-on:	R	C	J	**Let-through	-3dB (600Ω) BW	Order: (Number of wires)
T1 Data	36kA	±7Vdc	1Ω	30pF	425J	17Vp	120MHz*	**IS-T1** (4) **IS-3T1** (12)
RS232/562 Data	36kA	±20Vdc	1Ω	30pF	425J	24Vp	120MHz*	**IS-SPDDL** (2) **IS-DPDDL** (4) **IS-6PDDL** (12)
Current Loops	36kA	±27Vdc	<0.1Ω	30nF	425J	35Vp	65kHz	**IS-CLSP** (2) **IS-CLDP** (4) **IS-CL6P** (12)
Extension Lines	40kA	±75Vdc	20Ω @ 1%	11nF	550J	100Vp	30kHz	**IS-SPXL** (2) **IS-DPXL** (4) **IS-6PXL** (12)
Telco Trunks (Handles standard ring voltages to 105Vrms)	40kA	±200Vdc	20Ω @ 1%	2.4nF	550J	300Vp	250kHz	**IS-SPTL** (2) **IS-DPTL** (4) **IS-6PTL** (12)
RS422/423/485 Data	36kA	+2.8/-0.6Vdc	1Ω	30pF	425J	<+10/-1Vp	95MHz	**IS-SPHSD** (2) **IS-DPHSD** (4) **IS-6PHSD** (12)

*Measured across 110Ω system.
**Peak open circuit voltage at max current (wires vaporized)

MULTI-LINE SOLID STATE TWISTED PAIR PROTECTORS

APPLICATION:

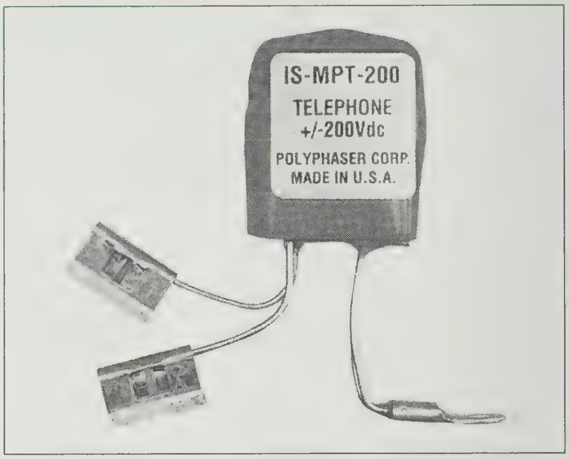
For more than 6 pair on 66 blocks, these protectors replace gas tubes and have many advantages.

- Fast response time
- Balanced turn-on voltage
- Three voltage for 66 type
- Lower differential voltage than 3 element gas tubes
- Lower harmonic energy than gas tube
- Clamps surges
- No fast dv/dt slew like crow bar tube action
- Fails in shorted mode like gas tubes
- Easily replaced if necessary, test with DIGI-FIST (see page 45)
- Balanced MOV type common mode protector
- One unit = one pair protector
- Stagger mount on 66 block for >8 lines (66 block not included)
- Adjustable ground bus for 66 block

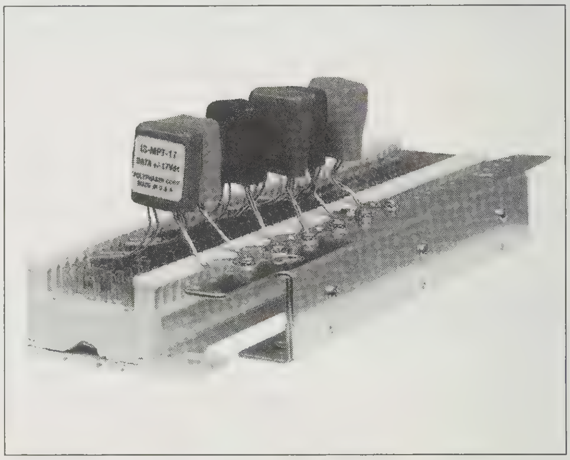
NON-STOCKED OPTIONS: IS-MPT units without bridging clip, specially designed units for KRONE blocks.

PRODUCT DIMENSIONS: See page 64.

Order: **IS-MPT-17** for data lines on 66 blocks
IS-MPT-24 for data lines on 66 blocks
IS-MPT-75 for extension lines on 66 blocks
IS-MPT-200 for trunk lines on 66 blocks



Model shown **IS-MPT-200**



Typical Mounting

MAXIMUM CHARACTERISTICS

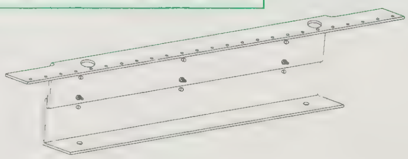
Application:	Surge: (per pair) IEC 1000-4-5 8/20μs waveform	Operating Voltage	Capacitance: (L to G)	Order:
T1 Data	4kA (60 Joules)	±17	27nF	IS-MPT-17*
RS232/422/485 Data	4kA (60 Joules)	±24	27nF	IS-MPT-24*
Extension Lines	4kA (72 Joules)	±75	5nF	IS-MPT-75
Telco Trunks	13kA (100 Joules)	±200	1.6nF	IS-MPT-200

Turn-on Time:
2.5ns for 2kV/ns

Temperature:
-25°C to +25°C

*Call factory for bandwidth.

Ground Bus for 66 block



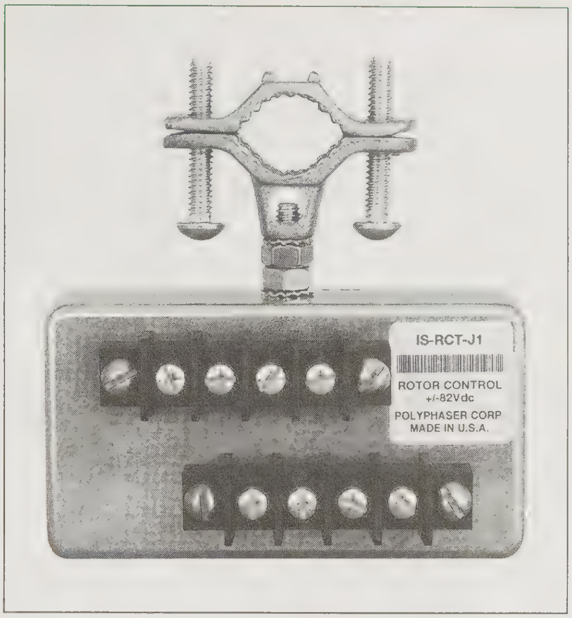
Order:

25P10GB for 25 pair 10" 66 block adjustable for 66 blocks with and without stands

ROTOR CONTROL 8 LINE PROTECTOR WITH SCREW TERMINALS

APPLICATION:

For protecting up to 8 line rotor controllers, helps protect motors, control box and other nearby equipment from damage by preventing strike energy from entering room.



Model shown **IS-RCT-J1**

- EMP rated
- Faster than gas tubes
- Lower turn-on than gas tubes
- Shunt type device for up to 8 lines
- Aluminum enclosure
- 16 crimp/solder lugs
- Rainproof (weatherize terminals use WK-1, page 51)
- Stainless steel mounting stud
- Available with bronze clamps for mounting on ground rods and tower legs

NON-STOCKED OPTIONS: Other voltages, in-line type protector, larger bronze clamps.

PRODUCT DIMENSIONS: See page 68.

MAXIMUM CHARACTERISTICS

Surge:
6500A (each line) IEC 1000-4-5
8/20μs waveform 72 Joules

Turn-on:
82Vdc ±10%

Turn-on Time:
<4ns

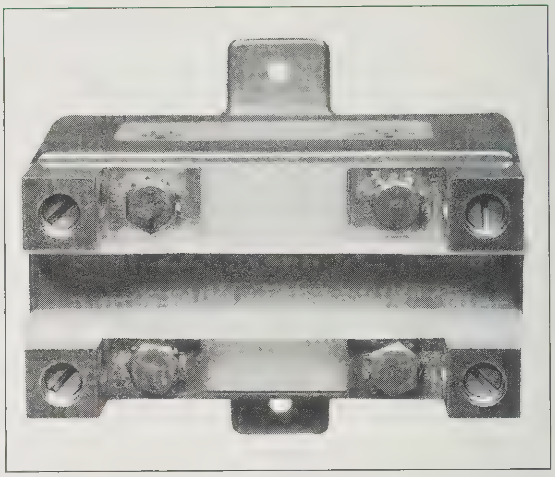
Temperature:
-40°C to +85°C Storage/Operating +50°C

Order: IS-Rotor Control Terminals - J clamp, size #
IS-RCT for protector with 1/4-20 x 13/16" mounting studs
IS-RCT-J1 for unit mounting 1/2" to 1-1/3" diameters
IS-RCT-J2 for unit mounting 1-1/2" to 2-1/4" diameters

DC BATTERY POWER PROTECTORS

APPLICATION:

Solar panels can capture large amounts of nearby strike energy due to their large area of traces. These protectors prevent this energy from entering the hut and protect the regulator.



Model shown **IS-24VDC-30A-FG**, flange mount

- Protects series pass and relay type regulators for 30A and 50A
- Has head room for open circuit arrays and battery surface charge
- Positive, negative and floating grounds
- Low resistance/voltage drop
- Housed use only
- Aluminum enclosure
- 18-8 stainless steel hardware

MIL SPECS: Many — call with requirements.

PRODUCT DIMENSIONS: See page 66 and 68.

MAXIMUM CHARACTERISTICS

Surge Per Pair:
18kA IEC 1000-4-5 8/20μs waveform

Turn-on:
18Vdc for IS-12VDC
27Vdc for IS-17VDC
35Vdc for IS-24VDC
53Vdc for IS-35VDC
80Vdc for IS-48VDC
100Vdc for IS-60VDC

Temperature:
-40°C to +65°C Storage/Operating +50°C

Turn-on Time:
<2ns

Resistance:
0.02Ω

Connections:
14 to 1/0AWG Compression Lug @30A
3/8-24 SS studs @50A

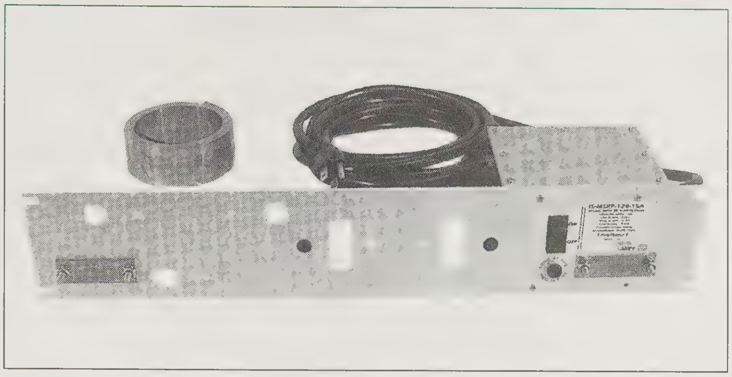
Order:

BASIC UNITS:	ADD SUFFIX:	
IS-12VDC	**-30A or -50A**	**-NG** (Negative Ground)
IS-17VDC	**-30A or -50A**	**-PG** (Positive Ground)
IS-24VDC	**-30A or -50A**	**-FG** (Floating Ground)
IS-35VDC		
IS-48VDC		
IS-60VDC		

MULTI-SUPPRESSOR RACK PANEL WITH BUILT-IN POWER PROTECTOR

APPLICATION:

Where a bulkhead panel can't be installed and a rack of equipment must be protected. All inputs and outputs should have protection and be grounded in common with the rack.

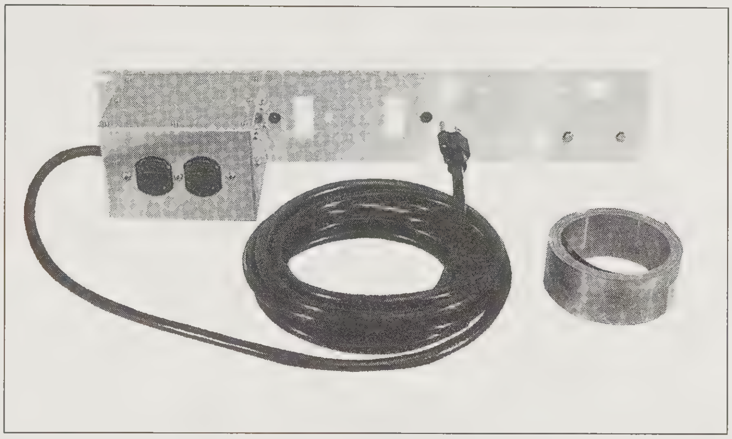

Model shown **IS-MSRP-120US15A** Front View

- **Provides a low inductance, single point grounding location**
- **Standard 19" rack size by 3.5" high and 1/8" aluminum**
- **Has IS-PLDO built on the panel** (See page 38 for technical info)
- **Copper blocks sandwich 1-1/2" x 20' copper strap for grounding**
- **Mounts up to three coaxial protectors**
- **Mounts either single or dual twisted pair protectors** (See pages 32 & 33)
- **U.S. 15A models NRTL listed UL #1449**

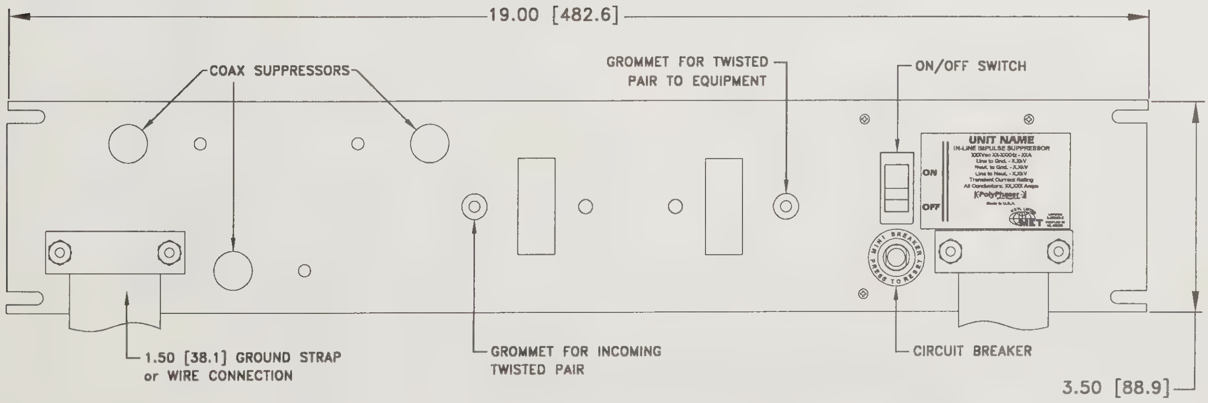
You may mount any three models from Group A or any two models from Group A and one model from Group B or any two models from Group B with any one model from Group A. Female connectors only.

NOTE: You may *not* have all three models from Group B.

GROUP A	GROUP B
IS-B50 SERIES IS-NEMP	ANY SMALL BOX TYPE ALUMINUM ENCLOSURE PROTECTOR


Model shown **IS-MSRP-120US15A** Back View

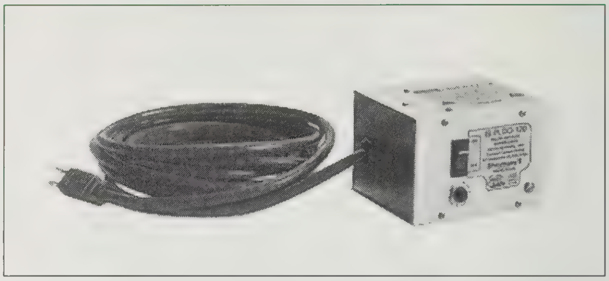
Order: *IS-MSRP-120US15A*
IS-MSRP-120US20A
IS-MSRP-240US15A
IS-MSRP-240AU10A
IS-MSRP-240CE15A
IS-MSRP-240UK10A
IS-MSRP-240IN15A
IS-MSRP-240IS15A


19.00 [482.6]
COAX SUPPRESSORS
GROMMET FOR TWISTED PAIR TO EQUIPMENT
ON/OFF SWITCH
UNIT NAME
IN-LINE IMPULSE SUPPRESSOR
ON
OFF
MINI BREAKER PRESS TO RESET
1.50 [38.1] GROUND STRAP or WIRE CONNECTION
GROMMET FOR INCOMING TWISTED PAIR
CIRCUIT BREAKER
3.50 [88.9]

POWER LINE EXTENSION PROTECTORS - 120/240Vac

APPLICATION:

Where equipment requires power line protection for surges/lightning, this unit will provide proper protection, filtering and grounding since it has an all metal grounded enclosure.



Model shown **IS-PLDO-120US15A**, flange mount

- NRTL listed – UL #1449 (Domestic only)
- In-line multi-stage (EMP rated) protectors
- All aluminum grounded enclosure/panel for lower inductance
- Multi-strike capability
- Extra long 15 foot SJT type cord - for 120Vac 15A unit
- Circuit breakered for added protection
- Master on/off switch
- Can be mounted/grounded to a Copper Single Point Ground Panel (See page 51.)
- Crimped and soldered terminal construction for reliability
- Duplex outlet adaptable to six outlets (Domestic)
- Matched MOV design for best clamping/ energy handling
- IS-PLDO models are duplex outlets
- IS-PLSO models are single outlets

MAXIMUM CHARACTERISTICS

Surge:
20kA IEC 1000-4-5 8/20µs waveform 800J (120Vac)
1.4kJ (240Vac)

Turn-on:
200Vdc (120Vac), 370Vdc (240Vac)

Turn-on Time:
Not defined due to filtering

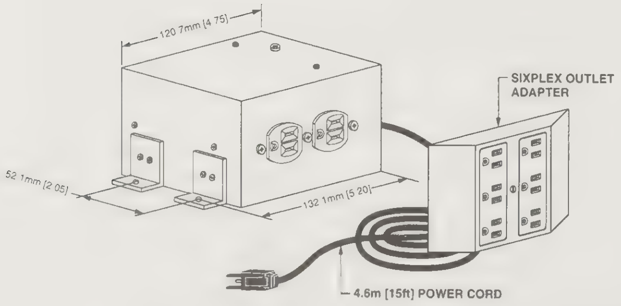
EMI/RFI Filtering: (Measured to Mil-STD-220)
-50dB @ 5MHz
-55dB @ 70MHz
-45dB @ 140MHz

Surge Let-Through Voltage:
IEC 1000-4-5 8/20µs waveform
400Vp to 10kA, 600Vp to 20kA (120Vac)
700Vp to 10kA, 1000Vp to 20kA (240Vac)

Temperature:
+5°C to +40°C Storage/Operating +40°C

Sixplex - for 120Vac duplex to six outlet adapter

PRODUCT DIMENSIONS:

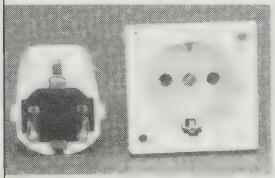
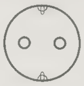
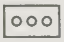
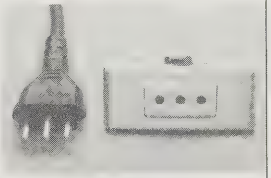
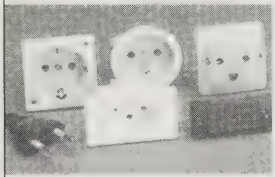
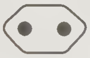
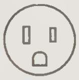
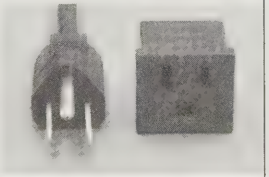
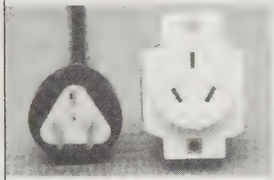
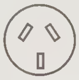
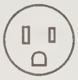
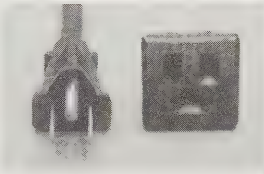
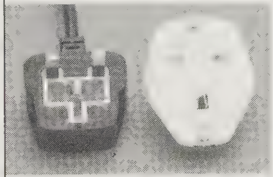
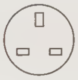
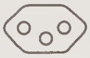
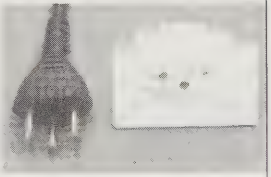
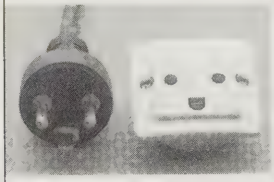
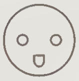
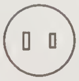
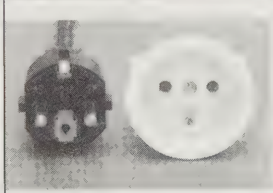
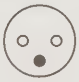
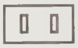
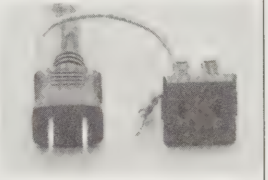
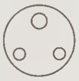
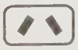
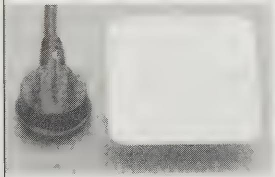
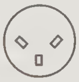


Order:

IS-PLDO-120US15A	for 120Vac with 15' cord, 15 Amps
IS-PLDO-120US20A	for 120Vac with 6' cord, 20 Amps
IS-PLDO-240US15A	for 240Vac with 10' cord, 15 Amps
IS-PLDO-240AU10A	for 240Vac with 2.5m cord, 10 Amps
IS-PLSO-240CE15A	for 240Vac with 2.5m cord, 15 Amps
IS-PLSO-240IN15A	for 240Vac with 2.5m cord, 15 Amps
IS-PLSO-240IS15A	for 240Vac with 2.5m cord, 15 Amps
IS-PLSO-240UK10A	for 240Vac with 2.5m cord, 10 Amps

Other international plug styles available. The International Plug Patterns are printed on page 39. Call for more information.

WORLDWIDE PLUG/SOCKET PATTERNS

Plug Pattern Type			Plug Pattern Type		
	**A** Cont. Europe CEE 7			**I** Italy	
	**B** CEE 7/16 Europlug (2.5A max.)			**J** Japan	
	**C** Australia			**K** North America (Nema 5-15)	
	**D** United Kingdom			**L** Switzerland	
	**E** Denmark			**M** Japan (Polarized) Non-grounded	
	**F** France/ Belgium			**N** Flat blade (Unpolarized) Non-grounded	
	G India (Old. Brit.)			**P** Australia Non-grounded	
	**H** Israel				

Information provided by Panel Components Corporation

POWER MAINS INFORMATION

There are many ways in which your equipment can get zapped via the power line. The obvious is a strike down the road which induces a surge on the power lines. However, a strike to your tower or a coupled surge to the phone lines can also get your equipment because the power line can provide a different path to ground. To ensure survival, all inputs and outputs (I/Os) must not only be protected but must be bonded in common via a common low inductance path to an earth ground. All grounds should be bonded in the earth to form a single earth system.

Power mains protectors are to be placed at the entrance panels, transfer switches or distribution panels. They should have a low inductance path to the earth system and be installed with the minimal lead inductance (short with gradual bends). For best protection, have an additional in-line power protector at or very near the sensitive equipment. This can not be a protector that only uses the wall outlet's grounding means, for it is too inductive to be much good. It should be a protector that can be mounted/grounded (like the IS-PLDO or IS-MSRP) to your main earth system.

TYPES OF POWER MAINS CONFIGURATIONS

Power mains come in several different configurations. The three basic ones are single, bi-phase and three phase. Three phase is sometimes called polyphase and has further divisional classes using the letters "Y", (written "Wye", and "Δ", the Greek letter Delta).

SINGLE PHASE

This is the simplest. It has a live or hot, a return called a neutral and a safety ground. This is commonly used for secondary wiring for a normal outlet. It may be any worldwide standard voltage. For the U.S.A., it is 120Vac (see drawing).

BI-PHASE

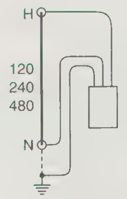
This is a common feed configuration. It may be obtained by either a single transformer, center tapped or by grounding one phase of a three phase delta. The former is often mis-called single phase in the U.S.A. since it often uses a single, center tapped, transformer fed from one of three high line phases. These phases are 180 degrees from each other thus 120Vac and 120Vac are available as well as 240Vac. This is typical for most houses in the U.S.A. (see drawing).

POLYPHASE OR THREE PHASE

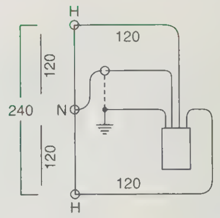
This is the feed for large facilities. The phases are 120 degrees apart. The Wye configuration normally always has a neutral/return which is grounded. The true delta (called a closed delta) normally does not have a ground. There is an open delta where a high leg (red lead) has a higher voltage to ground than the rest and there is a ground lead. A grounded delta has one leg grounded (see drawings).

VOLTAGES AVAILABLE AND WHERE USED

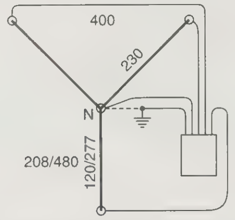
Voltages to 480Vac are used for normal feeds. The voltages will depend on the type of feed you have and on your country. Some places use different voltages than others. If you measure the phase to phase voltages and the phase to ground voltages, you will be able to determine the type of service you have. You will then need to look to see the current rating on the (largest) cutoff breaker.



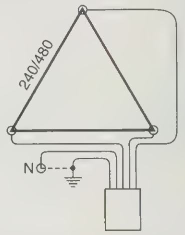
SINGLE PHASE (SP)
120, 240 or 480VAC



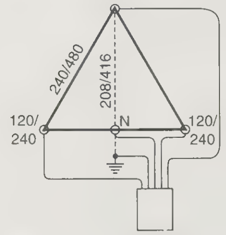
BI-PHASE (North American Only)



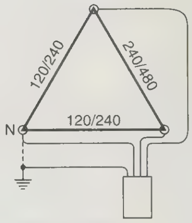
120/208 230/400 277/480 WYE (Y)



240 or 480 DELTA (D)



240 or 480 OPEN DELTA (O)



240 or 480
GROUNDED DELTA

CONNECTIONS FOR PROTECTORS

The connections for the protectors are given for each model and service type. Only the voltages change. The wires are properly color coded for identification.

SHUNT OR IN-LINE AND WHERE TO USE EACH

In-lines are load bearing; shunt types are not. In-lines are presently available to 400A. These have redundancy, better surge limiting and provide filtering. Shunt types have no real load current limit however the larger the load, the larger the wires, and the more the surge energy will follow the lines with the largest surface area. This means that more than one protector should be used. With some 20' separation (shielded) between protectors, they will almost equal a single in-line protector. Both types have alarm contacts and field replaceable surge components.

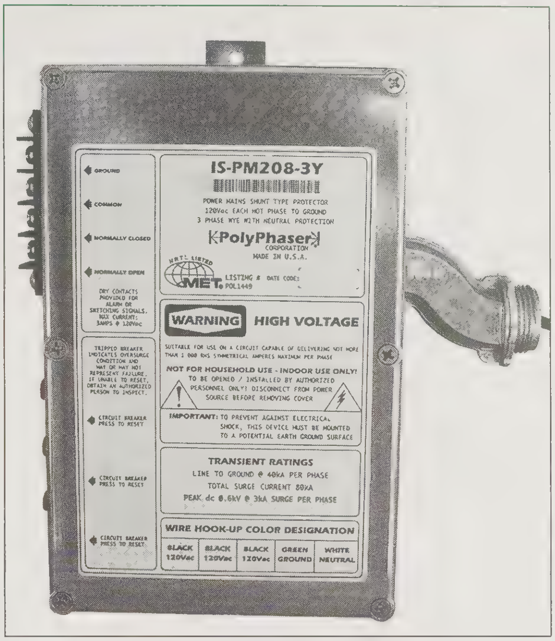
NRTL UL 1449 APPROVAL

PolyPhaser employs the services of MET Laboratories, Inc. to test and certify its products. MET is a Nationally Recognized Testing Laboratory (NRTL) and is approved by OSHA in the U.S.A. MET tests to all applicable standards including UL, ANSI, IEEE, NFPA, etc. MET is approved by the National Institute of Standards and Technology through the National Voluntary Laboratory Accreditation Program for Telecommunication and EMI Testing and is a National Certified Body in the IECEE Scheme. MET labels are accepted throughout the U.S.A. and in most countries.

POWER MAINS SHUNT TYPE LINE PROTECTOR

APPLICATION:

For building entrances where lightning energy may be shunted to an outside ground before it enters the building. The distance between the entrance and a sensitive electronic load should not be more than 10' unless another (in-line) protector is also being used on a single point ground.



Model shown **IS-PM208-3Y**, flange mount

- NRTL 1449 UL approved (120, 280, & 240 Vac only)
- Single, bi and three phase
- 120, 208, 240, 400 and 480Vac
- Surge energy is shunted to earth not to neutral
- Neutral protection for single earthed neutral sites
- Remote/local status dry contacts
- Breakered internally for safety - won't interrupt load power
- Field replaceable protection blocks - if needed
- Housed use only

NON-STOCKED OPTIONS: Lights, longer wire lengths available.

MIL SPECS: Many — call with requirements.

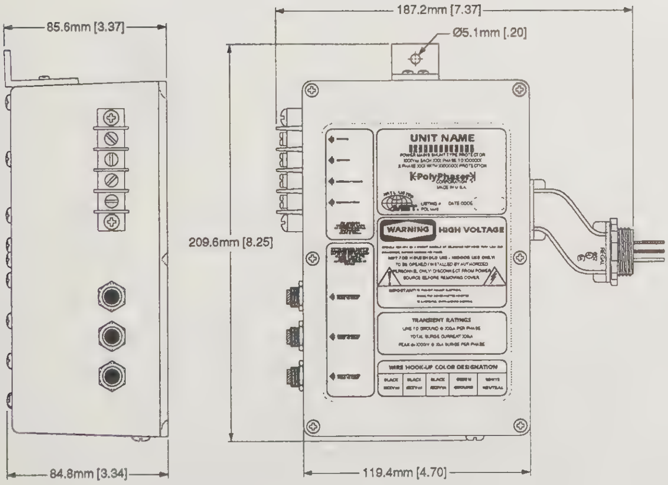
PRODUCT DIMENSIONS:

MAXIMUM CHARACTERISTICS

Surge:
40kA per phase IEC 1000-4-5 8/20μs waveform

Turn-on Time:
≤25ns for full lead length 2kV/ns

Temperature:
+5°C to +40°C Storage/Operating +40°C



Order:

120Vac	208 to 240Vac	400 to 480Vac	Phase Type
①**IS-PM120-SP**	②**IS-PM240-SP**	---	Single-phase
---	③**IS-PM240-BP**	---	Bi-phase (U.S. only)
---	④**IS-PM208-3Y**	⑤**IS-PM400-3Y**	3-phase Wye
---	---	⑥**IS-PM480-3Y**	3-phase Wye

Total unit surge current*:
①80kA ②80kA ③120kA ④160kA ⑤160kA ⑥160kA

Peak dc voltage from a 3kA* phase to ground (no load) surge:
①400V ②700V ③400V ④400V ⑤700V ⑥850V

Turn on voltage (phase to ground) dc (ac):
Note: phase to phase = 2 times
①205 (145) ②360 (255) ③205 (145) ④205 (145) ⑤360 (255) ⑥425 (300)

* Based on 8/20μs waveform.

POWER MAINS IN-LINE TYPE LINE PROTECTOR

APPLICATION:

Where outside originating line surges are a problem and they must be shunted and filtered to protect sensitive electronic equipment.

Model shown *IS-IL240-BP-200A*

- Single, bi and three phase
- 120, 208, 240, 400 and 480Vac
- Built-in redundancy - dual stages per phase with pi-network, low pass filtering
- Surge energy is shunted to ground not to neutral
- Neutral protection for single earthed neutral sites
- Front panel status
- Remote/local status dry contacts
- 100, 200 and 400A load currents per phase
- Protectors individually circuit breakered - won't interrupt load power
- Field replaceable protection blocks/circuit breakers if needed
- NRTL UL 1449 listing pending (100A & 200A)
- Housed use only

NON-STOCKED OPTIONS: NEMA 3 and 4X enclosures.

MIL SPECS: Many — call with requirements.

MAXIMUM CHARACTERISTICS

Surge:
45kA per phase IEC 1000-4-5 8/20μs waveform

Turn-on Time:
Not defined due to filtering

EMI/RFI Filtering: (Mil-STD-220)
-30dB 1.2MHz, -30dB 8MHz, -31.4dB 10MHz

Temperature:
-25°C to +60°C Storage/Operating +40°C

Order:

120Vac	208 to 240Vac	400 to 480Vac	Phase Type
①**IS-IL120-SP**	②**IS-IL240-SP**	---	Single-phase
---	③**IS-IL240-BP**	---	Bi-phase (U.S.A. only)
---	④**IS-IL208-3Y**	⑤**IS-IL400-3Y**	3-phase Wye
---	---	⑥**IS-IL480-3Y**	3-phase Wye

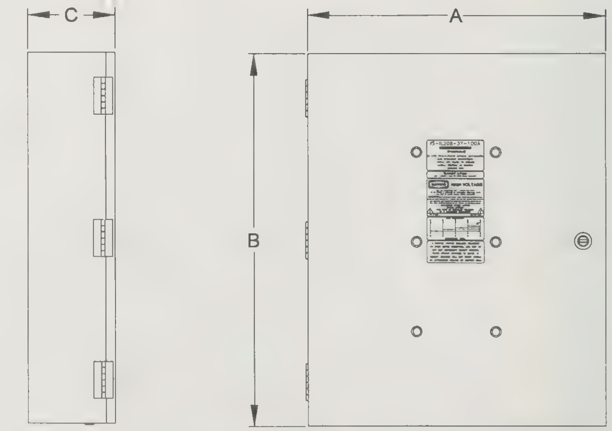
Note: You must add:
-100A for 100A/phase usable power
-200A for 200A/phase usable power
-400A for 400A/phase usable power
(i.e. **IS-IL240-BP-100A**)

Total unit surge current*:
①90kA ②90kA ③130kA ④175kA ⑤175kA ⑥175kA

Peak dc voltage from a 3kA* phase to ground (no load) surge:
①400V ②700V ③400V ④400V ⑤700V ⑥850V

Turn-on voltage (phase to ground) dc (ac):
Note: phase to phase = 2 times
①205 (145) ②360 (255) ③205 (145) ④205 (145) ⑤360 (255) ⑥425 (300)

* Based on 8/20μs waveform.

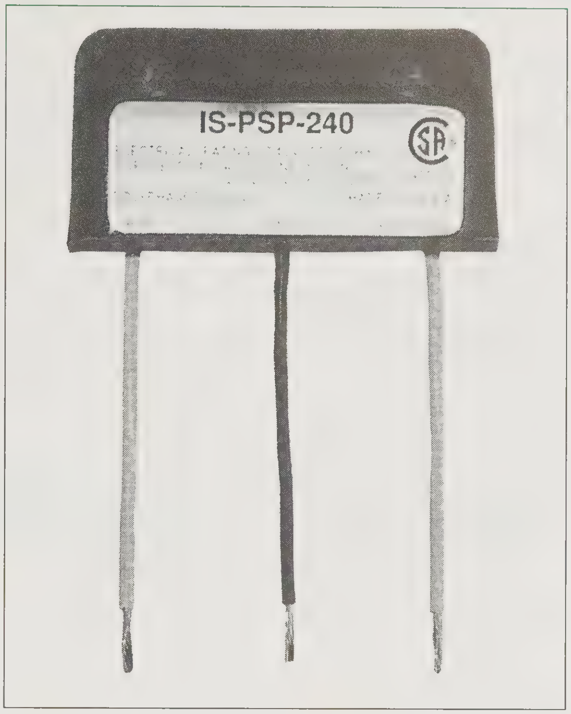


DIMENSIONS (inches [mm])			
UNIT	A	B	C
IS-IL120-SP 100A & 200A	16.235 [412.4]	24.16 [613.7]	6.62 [168.2]
IS-IL240-SP 100A & 200A	16.235 [412.4]	24.16 [613.7]	6.62 [168.2]
IS-IL240-BP 100A & 200A	24.00 [609.6]	24.00 [609.6]	6.62 [168.2]
IS-IL208-3Y 100A & 200A	24.00 [609.6]	30.00 [762.0]	7.00 [177.8]
IS-IL400-3Y 100A & 200A	24.00 [609.6]	30.00 [762.0]	7.00 [177.8]
IS-IL480-3Y 100A & 200A	24.00 [609.6]	30.00 [762.0]	7.00 [177.8]

HARDWIRE POWER SUPPLY SHUNT PROTECTOR

APPLICATION:

Used for military equipment protection - incorporated within the equipment and properly fused or breakered.



Model shown **IS-PSP-240**

- Low cost
- Superior because it is referenced to your equipment
- High speed MOV and high current gas tube combination
- Long life 0.84 Coulomb
- Must be locally fused/breakered (15A)
- Soldered in place
- 1-3/4" long #20AWG leads
- Housed use only
- CSA listed - LR#106164-1

MIL SPECS: Many—call with requirements.

PRODUCT DIMENSIONS: See page 62.

MAXIMUM CHARACTERISTICS

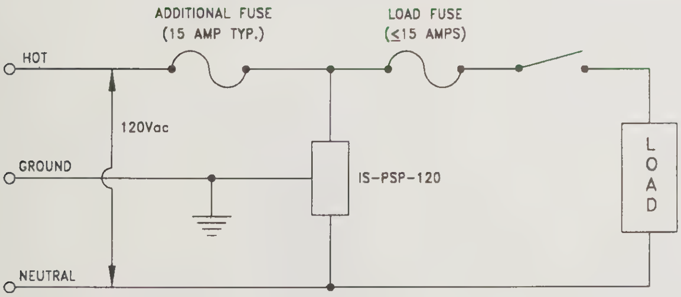
Surge: 35kA IEC 1000-4-5 8/20μs waveform 875 Joules

Turn-on:	IS-PSP-120	±200Vdc L to N
		±300 to 500Vdc L to G
	IS-PSP-240	±350Vdc L to L
		±500 to 800Vdc L to G

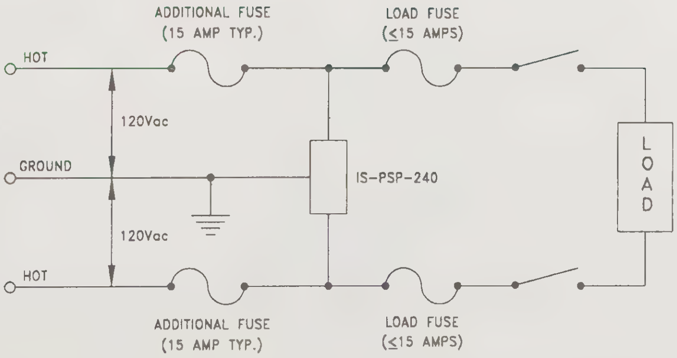
Turn-on Time: 2ns L to L, 10ns L to G for 2kV/ns

Order:

IS-PSP-120 for 120Vac
IS-PSP-240 for 240Vac



Recommended installation for IS-PSP-120.



Recommended installation for IS-PSP-240.

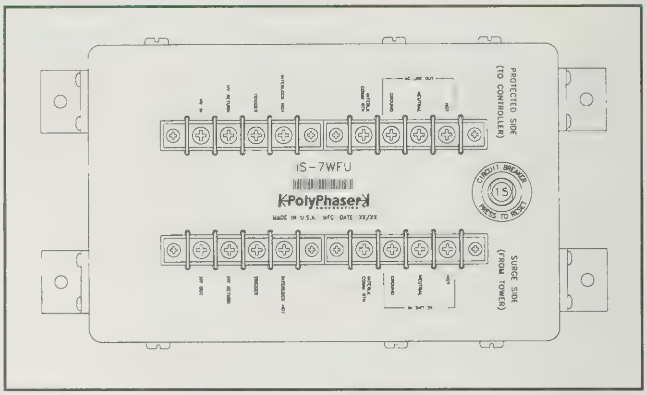
DROP-IN TOWER STROBE FLASHER PROTECTOR

APPLICATION:

To prevent lightning energy from damaging strobe flasher and getting into power lines of building.

- Single or double strobe flasher models
- In-line protector for ac, HV, HV return, trigger and interlock lines
- Housed use only - fits inside some control boxes

PRODUCT DIMENSIONS: See page 69.



Model shown **IS-7WFU**, flange mount

MAXIMUM CHARACTERISTICS

	Surge:*	Turn-on:	Usage:
ac	15kA	200Vdc	120Vac 15A
HV & return	6.5kA	2000Vdc	2000Vdc
trigger & return	10kA	400Vdc	350Vdc
interlock	15kA	200Vdc	120Vac

* (IEC 1000-4-5 8/20μs waveform)

Order:

IS-7WFU for single (7 wire) flasher unit
IS-12WFU for dual (12 wire) flasher unit

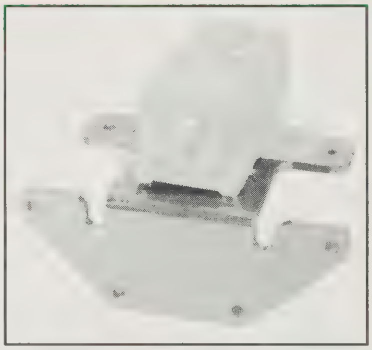
FLANGE TO BULKHEAD and BULKHEAD TO FLANGE ADAPTERS

APPLICATION:

FB ADAPTER adapts PolyPhaser flange mountable protector to a bulkhead panel.

BF ADAPTER adapts PolyPhaser bulkhead mountable protector to a single grounding panel or other flat surface.

- Both FB & BF Adapters provide a low inductance, large surface area connection
- FB Adapter designed to mount to any PolyPhaser Bulkhead, PEEP or PEP entrance panel
- FB Adapter designed to accommodate any PolyPhaser flange mountable design
- BF Adapter designed for female connectors handling all bulkhead protectors



NEW - FB ADAPTER

Model shown **BF ADAPTER**

Order:

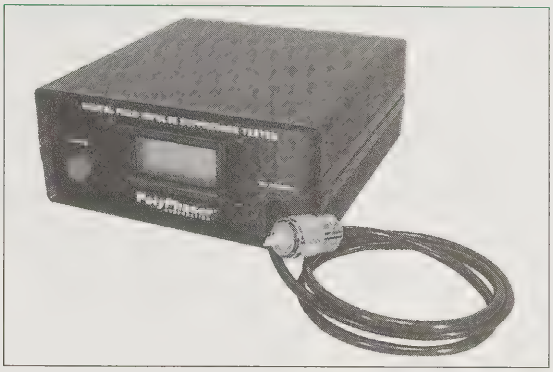
FB ADAPTER - Flange to Bulkhead Adapter
BF ADAPTER - Bulkhead to Flange Adapter

Note: Protectors not included with adapters.

HIGH VOLTAGE PORTABLE BREAKDOWN TESTER

APPLICATION:

Where any Impulse Suppressor to 2000Vdc must be tested.



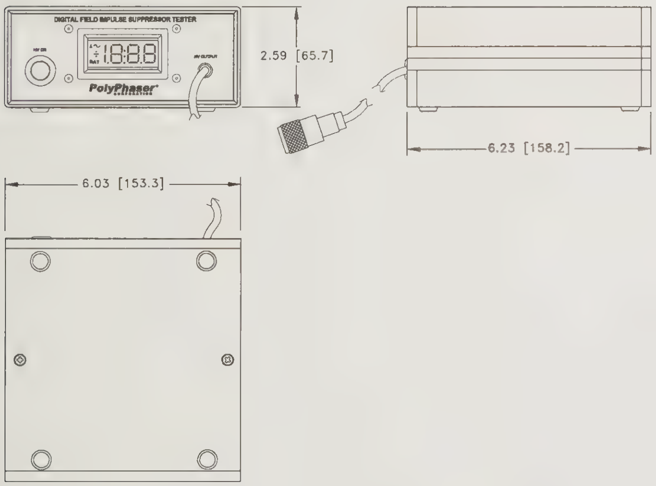
Model shown **DIGI-FIST**

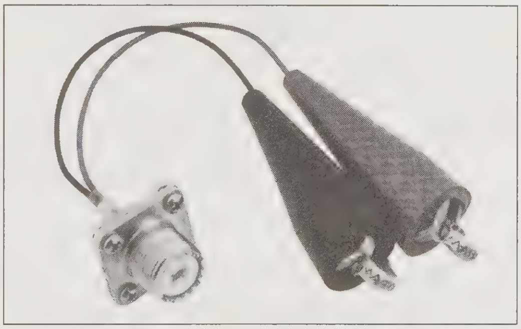
- Constant 1mA current output
- 3 1/2 digit LCD display
- Use for pass/fail for Mil-188-125 POE testing
- Runs on 9V battery pack
- Reads gas tubes turn-on
- Tests MOV, zeners and other SAS type protectors
- 2000V scale
- Safe push to test button
- Tests all PolyPhaser protectors
- UHF to N adapter, high voltage 6" clip leads and padded nylon case with hands free neck strap/side storage pouch included

Order:

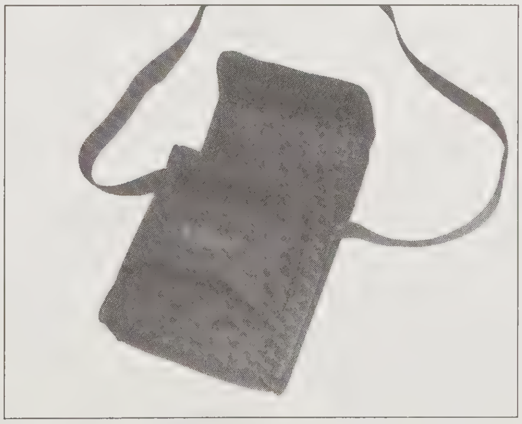
DIGI-FIST

PRODUCT DIMENSIONS:





Clip Leads — included



Nylon Case — included

LIGHTNING STRIKE COUNTERS

APPLICATION:

To determine where strike energy is occurring, For preventive maintenance and testing of protectors, To show how many times your PolyPhasers® have protected your equipment.

Model shown **LSC-12**, flange mount

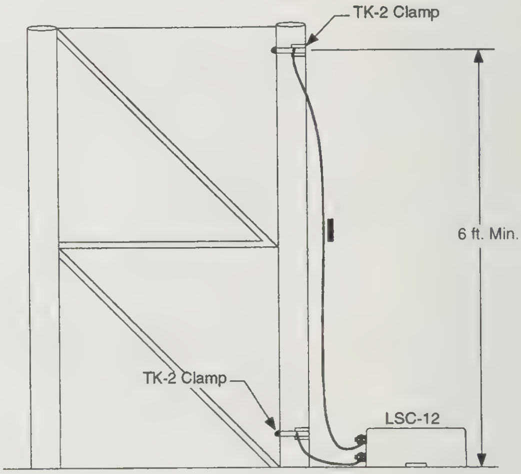
- Internally protected
- Counts to 999,999

NON-STOCKED OPTIONS: LSC-13 without counter – contacts only; Lightning strike counters available for Phone Lines and Plug-in Power Lines upon request.

LSC-12 TOWERS, PIPELINES, LIGHTNING DOWN CONDUCTORS

- Uses the tower, etc. as an inductive shunt; voltage drop across the shunt triggers the counter
- Requires an electrical connection spaced 6' to 10' for Rohn 25 larger spacing for larger towers. The larger the lead separation the greater the counter's sensitivity.
- Use a #14 or larger wire gauge for connections with TK clamps (page 54) and CCK (page 52) for corrosion free joints
- Momentary test with either polarity battery from 9V to 50V
- Rainproof and may be left outdoors but do not open, factory sealed

Order: **LSC-12** Tower Strike Counter



LSC-13 TOWERS, PIPELINES, LIGHTNING DOWN CONDUCTORS

- Provides dry contacts for computer monitoring
- One 9V battery included
- Contact closure time is proportional to strike energy
- Uses the tower, etc. as an inductive shunt; voltage drop across the shunt triggers the counter
- Requires an electrical connection spaced 6' to 10' for Rohn 25 larger spacing for larger towers. The larger the lead separation the greater the counter's sensitivity.
- Use a #14 or larger wire gauge for connections with TK clamps (page 54) and CCK (page 52) for corrosion free joints
- Momentary test with either polarity battery from 9V to 50V
- Site sealable for outdoor use with WK-1 (page 51)

Order: **LSC-13** Tower Strike Counter with Contact Closure

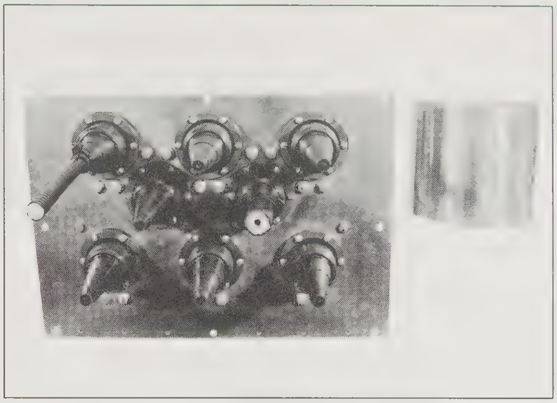
PRODUCT DIMENSIONS: See page 69.

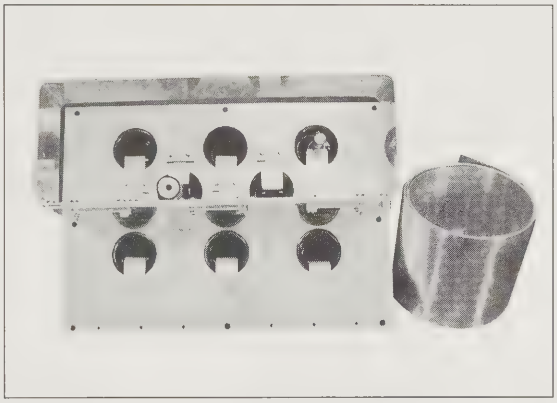
POLYPHASER ENTRANCE PANEL (PEP) - NEW

APPLICATION:

To divert lightning energy to earth prior to reaching equipment. Provides grounding for coaxial cables entering a facility, the outside shield and coaxial protectors. Establishes a central single point ground connection.

- Ease of installation with inside coax access to single center copper plate
- Provides for various length cable connections to protectors with flexible grounding to copper strap
- Allows for cables to enter at varying angles
- Accommodates cable from 1/2” to 1” diameter
- Constructed of rugged 1/8” copper
- Designed for grounding as well as watertight penetration
- Single entry panel with 6" wide by 15' long copper straps for low inductance, high surface area with sandwich bar connection for below grade lug or exothermic interconnection to the perimeter ground cable
- Cut to fit cable diameter cone-shaped weather boots

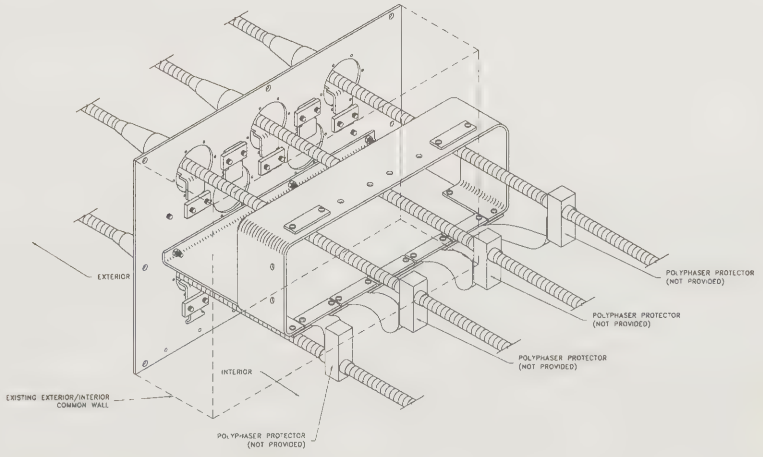




Order:

8PEP - 8 port entrance system

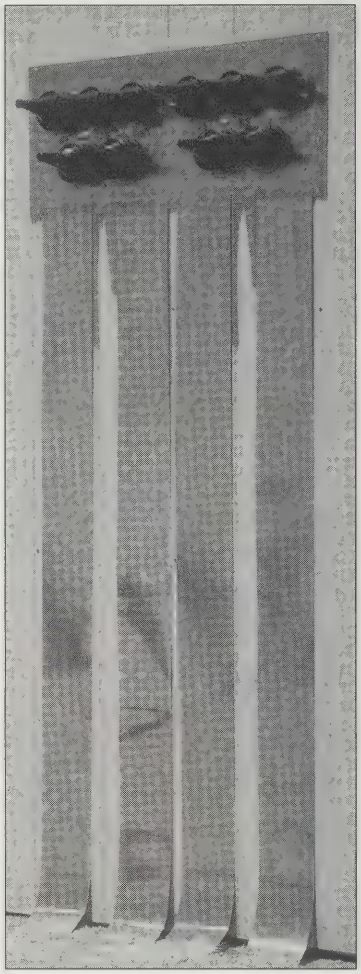
TYPICAL INSTALLATION


EXTERIOR
INTERIOR
EXISTING EXTERIOR/INTERIOR COMMON WALL
POLYPHASER PROTECTOR (NOT PROVIDED)
POLYPHASER PROTECTOR (NOT PROVIDED)
POLYPHASER PROTECTOR (NOT PROVIDED)
POLYPHASER PROTECTOR (NOT PROVIDED)

GROUNDED BULKHEAD ENTRANCE & PEEP PANELS

APPLICATION:

Where coaxial cables enter a facility and both grounding of the outside shield and coaxial protectors are desired to protect electornic equipment as well as for establishing a central single point ground location.



- Easy installation
- Handles up to 3 1/8" rigid line (without EIA flange) and up to EW28 type elliptical line (without flange)
- Provides grounding as well as watertight penetration
- Built in protected cable grounding boots
- 6" wide 15' long copper straps provide low inductance, high surface area with sandwich bar connection and joint compound for below grade lug or exothermic interconnection to the perimeter ground cable
- Boot made of EPDM +300, -60°F, excellent UV and atmospheric stability, expands to 200% to fit over cable
- Made of special hardness copper to allow threaded holes to provide extra surface area interconnections
- 18-8 stainless steel hardware and 300 series stainless clamps

BP BULKHEAD PANELS

- Removable universal pre-punched protector mounting plates on U-panel allow for easy installation and for rigid or elliptical line penetrations
- U-panel allows for indoor access only to the coax connections for a safe, dry and reliable installation
- U-panel provides a low inductance grounding means for the coaxial protectors and can be used as a central single point ground for the entire facility

Order:

3PB - fits into single concrete block
5PB - 2ea. 6" straps
8PB - 2ea. 6" straps
10PB - 4ea. 6" straps two 5PB
16PB - 4ea. 6" straps two 8PB
24PB - 4ea. 6" straps three 8PB

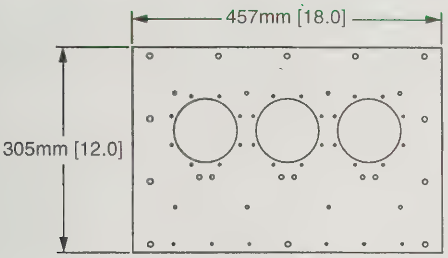
PEEP POLYPHASER EARTHED ENTRANCE PANELS

- Easy inside coax line access
- Inside horizontal plates provide sandwich connections to flexible copper straps for grounding the coaxial protectors
- Design allows for various length cable connections to the protectors as well as accommodating cables entering at slight angles
- Horizontal plates have hole locations for bolting other equipment grounding cables to form a single point room ground

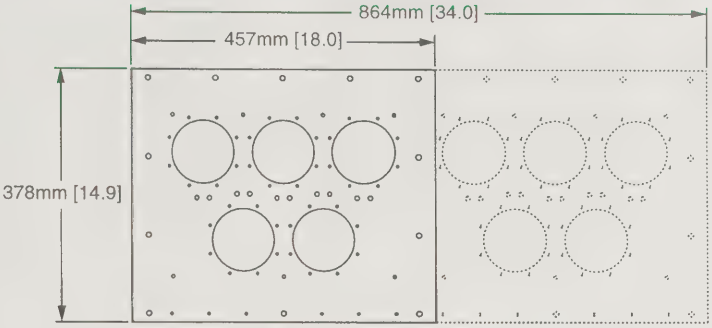
Order:

3PEEP - 3 port entrance system
5PEEP - 5 port entrance system
8PEEP - 8 port entrance system
10PEEP - 10 port entrance system
16PEEP - 16 port entrance system
24PEEP - 24 port entrance system

GROUNDED BULKHEAD ENTRANCE & PEEP PANELS

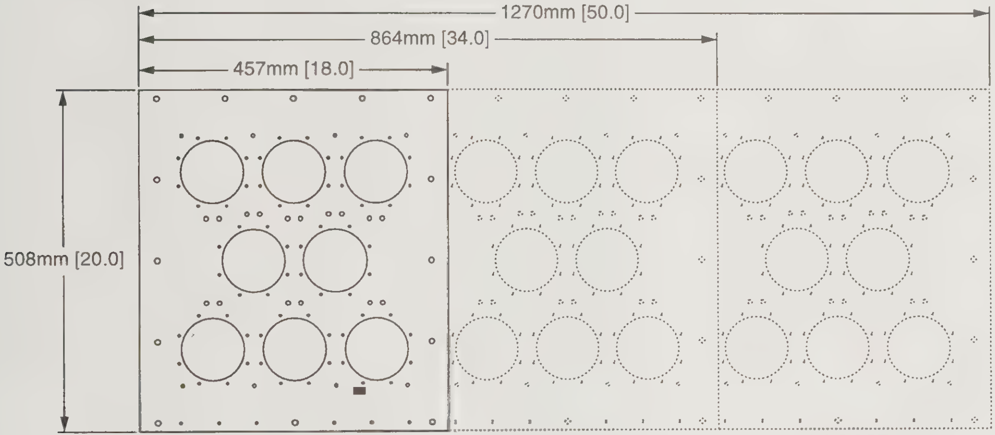


3 PORT
WALL HOLE SIZE
for PANEL(S)
365mm [14.38] wide
by 203mm [8.00] high



5 PORT
WALL HOLE SIZE
for PANEL(S)
365mm [14.38] wide
by 277mm [10.9] high

10 PORT
WALL HOLE SIZE
for PANEL(S)
772mm [30.38] wide
by 277mm [10.9] high

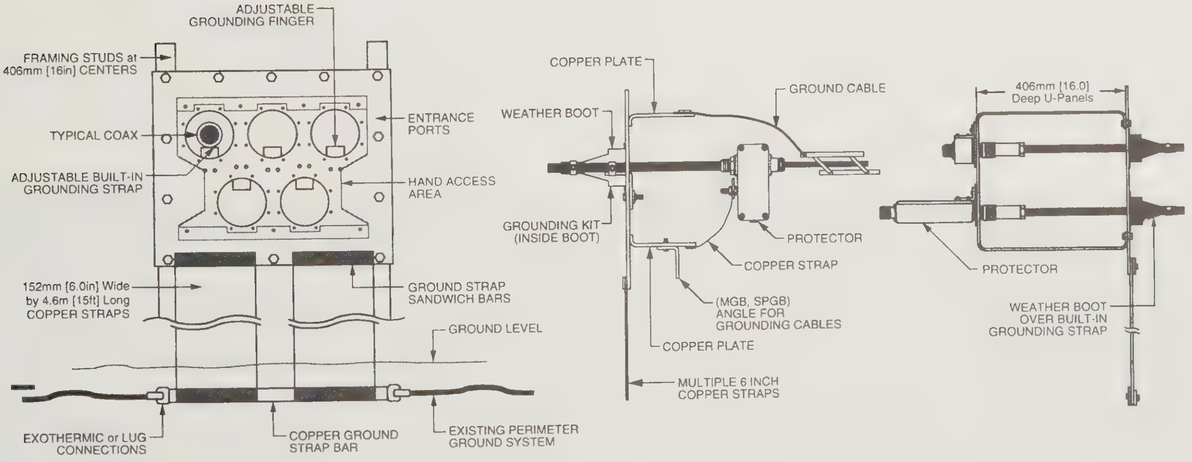


8 PORT
WALL HOLE SIZE
for PANEL(S)
365mm [14.38] wide
by 406mm [16.0] high

16 PORT
WALL HOLE SIZE
for PANEL(S)
772mm [30.38] wide
by 406mm [16.0] high

24 PORT
WALL HOLE SIZE
for PANEL(S)
1178mm [46.38] wide
by 406mm [16.0] high

TYPICAL INSTALLATION


ADJUSTABLE GROUNDING FINGER
FRAMING STUDS at 406mm [16in] CENTERS
TYPICAL COAX
ENTRANCE PORTS
ADJUSTABLE BUILT-IN GROUNDING STRAP
HAND ACCESS AREA
152mm [6.0in] Wide by 4.6m [15ft] Long COPPER STRAPS
GROUND STRAP SANDWICH BARS
GROUND LEVEL
EXOTHERMIC or LUG CONNECTIONS
COPPER GROUND STRAP BAR
EXISTING PERIMETER GROUND SYSTEM
COPPER PLATE
GROUND CABLE
WEATHER BOOT
GROUNDING KIT (INSIDE BOOT)
PROTECTOR
COPPER STRAP
(MGB, SPGB) ANGLE FOR GROUNDING CABLES
COPPER PLATE
MULTIPLE 6 INCH COPPER STRAPS
406mm [16.0] Deep U-Panels
PROTECTOR
WEATHER BOOT OVER BUILT-IN GROUNDING STRAP

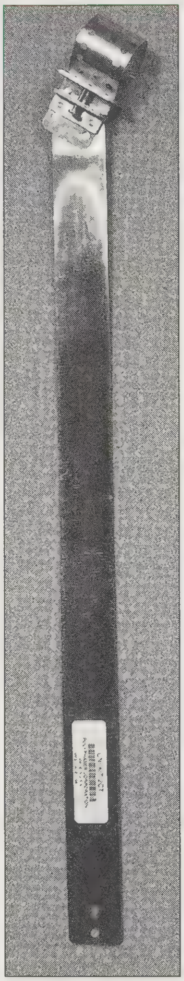
Front View: PEEP, Bulkhead **Side View: PEEP** **Side View: Bulkhead**

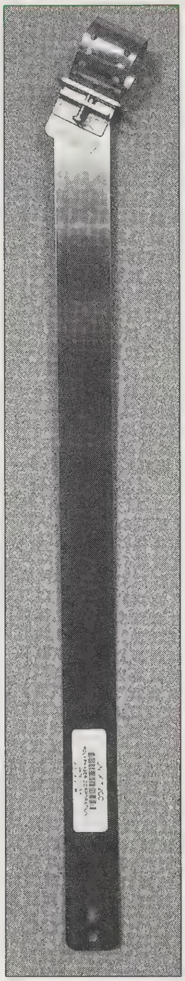
CABLE GROUNDING KIT SERIES – UNI-KIT 2 & UNI-KIT 4

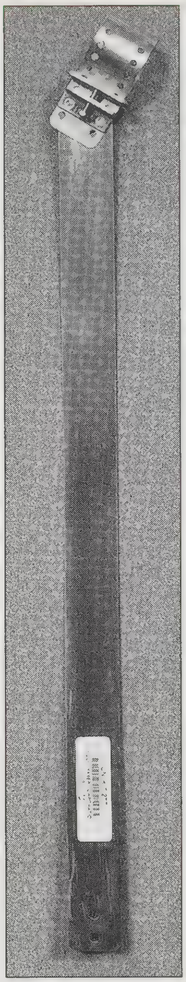
APPLICATION:

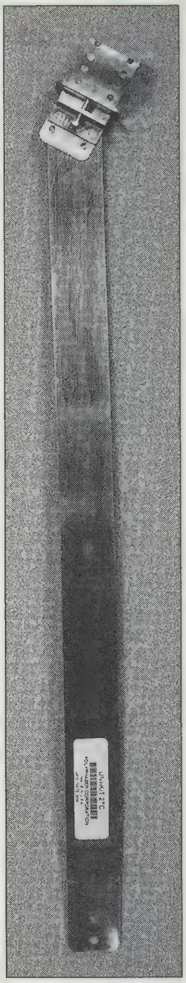
Coax grounding is required to provide an effective ground path to prevent energy from reaching equipment. Integrating copper strap as a conductor provides an improved surface area connection to the cable thus reducing inductance.

- UNI-KIT 4 fits 2 1/8" to 4" diameter and elliptical waveguides up to EW20
- UNI-KIT 2 fits cables from 1/4" to 2 1/8" diameter and elliptical waveguides up to EW44
- Lower resistance and inductance
- 24" copper tail is weather protected to prevent tower corrosion damage
- Provides a high current ground path tested to 50kA
- Eight models with specially coated ends for no dissimilar connections
- Two NEMA-spaced tail grounding holes provided with stainless (1/4-20x3/4) hardware
- Vibration and wind tested
- Quick nut driver installation
- Adjustable strap to cable angle
- Traditional weatherizing materials included
- Copper strap reduces resistance, inductance and voltage drop
  Resistance: 680µΩ
  Inductance: 0.3µH
  Total Voltage Drop for a
  20kA [8/20µs] Strike: 763V


UNI-KIT 2CT


UNI-KIT 2CC


UNI-KIT 2TT


UNI-KIT 2TC

CHARACTERISTICS

Type of metal to be grounded (top clamping end)	Grounding to (bottom end)	Diameter	*Order:*
COPPER or BRASS	ALUMINUM or TIN or GALVANIZED	1/4" thru 2-1/8" 2-1/8" thru 4"	UNI-KIT 2CT UNI-KIT 4CT
COPPER or BRASS	COPPER or BRASS	1/4" thru 2-1/8" 2-1/8" thru 4"	UNI-KIT 2CC UNI-KIT 4CC
ALUMINUM or TIN or GALVANIZED	ALUMINUM or TIN or GALVANIZED	1/4" thru 2-1/8" 2-1/8" thru 4"	UNI-KIT 2TT* UNI-KIT 4TT
ALUMINUM or TIN or GALVANIZED	COPPER or BRASS	1/4" thru 2-1/8" 2-1/8" thru 4"	UNI-KIT 2TC* UNI-KIT 4TC

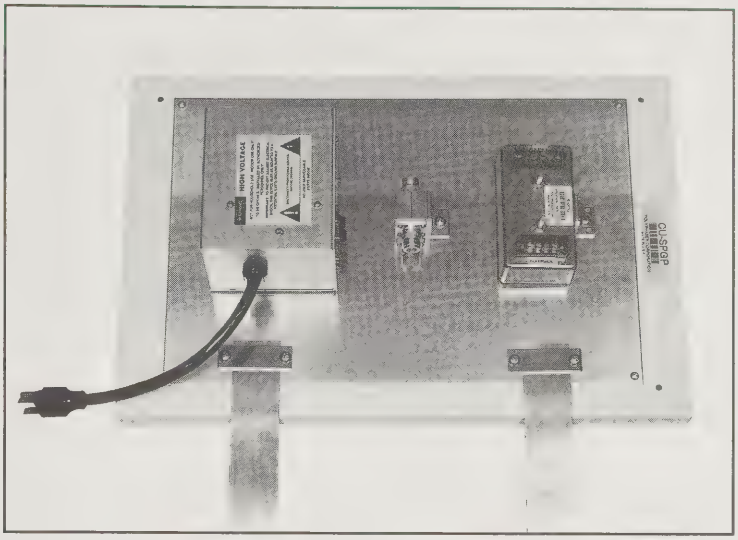
** Can also be used for grounding a galvanized tower leg.*

COPPER GROUNDING PANELS

APPLICATION:

Where a grounded xentrance panel cannot be installed due to ownership, etc. and it is desired to provide proper and effective protection to a small group or rack(s) of equipment, this panel may be used to mount/ground protectors and to establish a single point grounding location for grounding the racks/chassis of equipment.

- Simple to install
- Fits 16" on center stud construction
- Comes with 4 lead molly anchors for concrete
- Copper plate 0.062"
- Melamine covered particle board
- Ten product mounting screws
- Two rolls of 10' x 1-1/2" copper grounding strap
- Two copper sandwich bars for the strap



Model shown **CU-SPGP**

Protectors installed on panel shown above are not included with CU-SPGP.

Order: **CU-SPGP** for Copper Single Point Ground Panel

NON-STOCKED OPTION: For 20" on center stud construction.

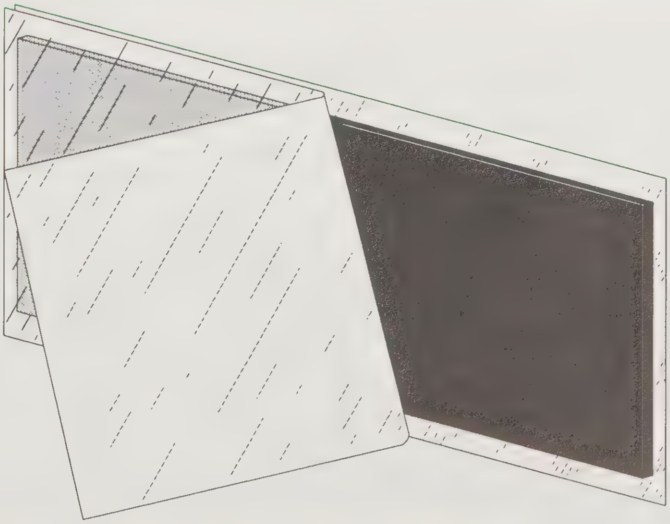
WEATHER PROOFING KIT MATERIAL

APPLICATION:

Where a weather tight seal is needed with an extreme temperature range and exposed to UV.

- Non-conductive
- Reusable
- Withstands -65°F to +180°F without cracking
- Paintable - latex or solvent based paints
- Water impermeable (Mil-S-19653A)
- Exceptional UV and salt spray resistance
- Non-irritating to skin
- Black – self adhering
- Hand applied
- Measures 2.5" by 6" by 1/8"

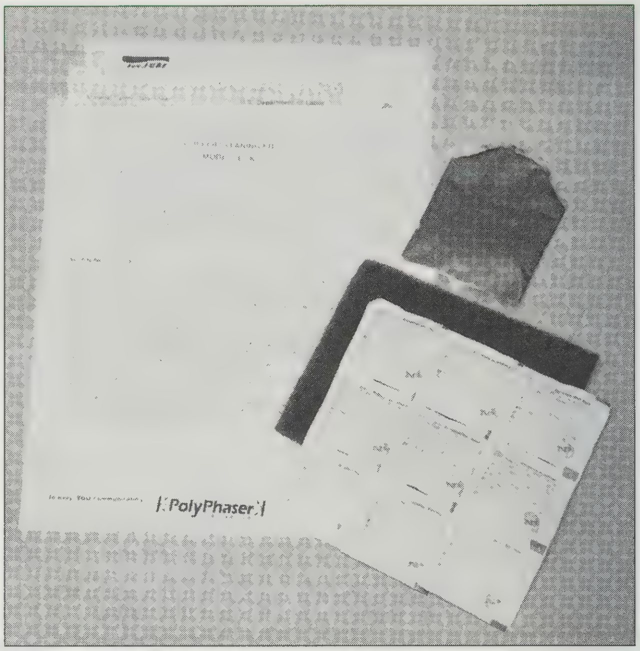
Order: **WK-1**



COPPER CLEANING KIT

APPLICATION:

Provides a means to clean copper and weather seal connections from moisture and corrosion.



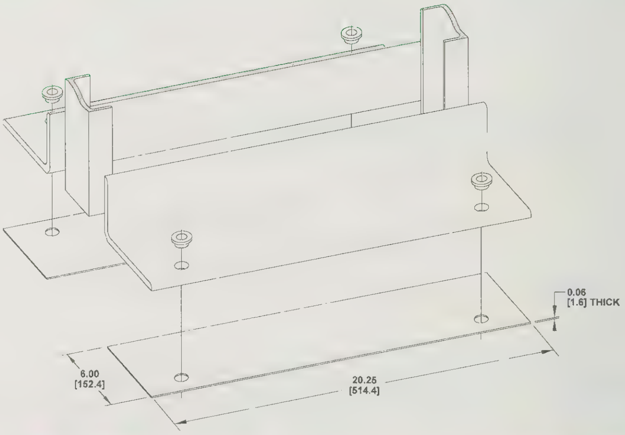
- Silicone based copper joint compound
- Finger towelettes for clean up
- MSDS information and instructions included
- Assures clean and corrosion free connections
- Hylon abrasive scrub pad

Order: CCK

RACK ISOLATION KIT

APPLICATION:

Isolate equipment racks from floor to prevent multiple ground paths. Kit can be utilized on existing racks, new installations, concrete floors or structures, and metal floors and enclosures.



- Isolation pads made of high dielectric polypropylene
- Promotes single point grounding
- Easy installation
- Designed for new installations as well as existing racks
- Mounts with standard 1/2" or 3/8" diameter hardware

Order: RACK ISO KIT 19
RACK ISO KIT 23

MAXIMUM CHARACTERISTICS

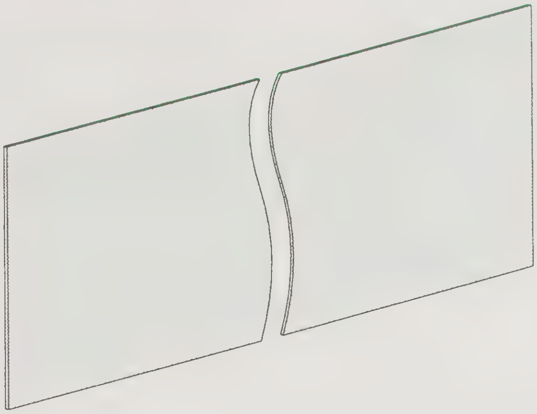
Breakdown Voltage:
6kV

Compression Strength:
1200 psi – Isolation Pad
5000 psi – Washers

LOW INDUCTANCE COPPER INTERCONNECT STRAP

APPLICATION:

Where any wire ground path is used the copper strap will have lower inductance. Radials on bare mountain tops - the strap's sharp edge will allow a lower voltage side flashing to the bare rock than wire.



- Lower inductance than wire
- 1.5" strap has a lower inductance than #2/0 stranded wire
- Easy to work with (cut, solder, etc.)
- Sold in increments of 25', 50', 75' & 100'
- 26 AWG thickness (0.0159")
- Can not be fused open by lightning
- Above or in ground usage
- Can be sandwiched for exothermic welding
- Can be used with TK series clamps (see page 54)
- 1-1/2" can be used with strap connector clamps (see page 54)

Order:

1.5" Strap-feet	3.0" Strap-feet	6.0" Strap-feet	Length
CS112-25	**CS3-25**	**CS6-25**	*25 feet*
CS112-50	**CS3-50**	**CS6-50**	*50 feet*
CS112-75	**CS3-75**	**CS6-75**	*75 feet*
CS112-100	**CS3-100**	**CS6-100**	*100 feet*

NON-STOCKED OPTIONS: 200, 300, 400 and 500 foot lengths available.

CHARACTERISTICS

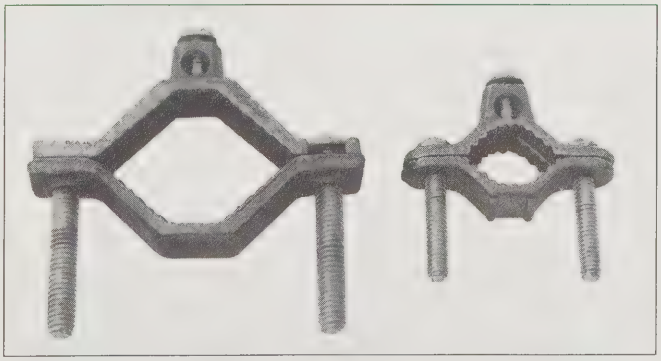
	1.5" STRAP	3.0" STRAP	6.0" STRAP
Cross-sectional area in square inches	0.0239	0.0478	0.0956
Closest stranded wire size to the above area	#6 AWG (0.02062)	#3 AWG (0.04134)	#2/0 AWG (0.1045)
Inductance of wire for eight feet	3.362μH	3.194μH	2.961μH
Inductance of strap for eight feet	2.273μH	2.067μH	1.940μH
% decrease of inductance of strap over wire for eight feet	22.5%	28.8%	34.5%

NOTE: 1.5" strap has lower inductance than #2/0 AWG cable.

BRONZE TRANSITION CLAMPS WITH ALL STAINLESS SCREWS

APPLICATION:

Can be used to bond wire to ground rods, fire risers, etc.



- Two adjustable sizes
- Cast bronze
- 18-8 stainless screws
- For wire sizes #2 stranded to #10 solid

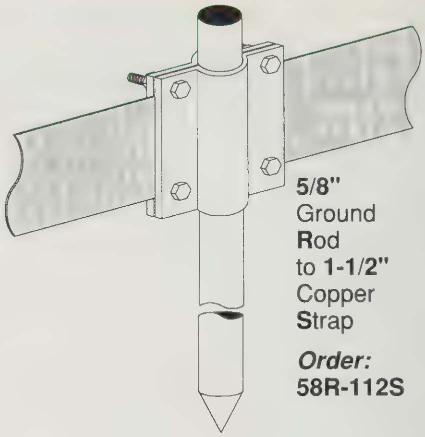
Order: **J-1** for 1/2" to 1-1/3" diameters
J-2 for 1-1/2" to 2-1/4" diameters

CLAMP BONDS

APPLICATION:

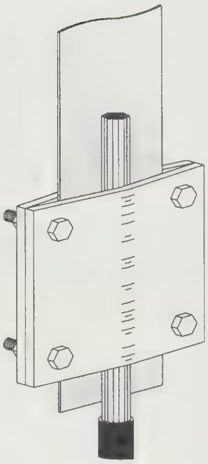
To bond copper strap without having to build up the joint for an exothermic weld.

- Faster installation than exothermic welding
- Copper to copper will not corrode
- <0.0001Ω resistance
- All copper sandwich with 18-8 stainless hardware
- Large contact surface which smashes the strap into place
- Can be used for 1-1/2" to 6" copper strap



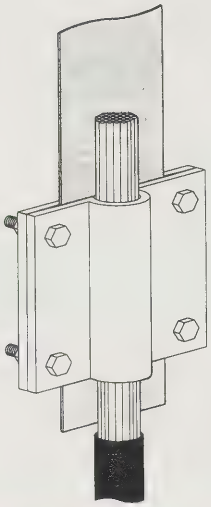
5/8"
Ground
Rod
to **1-1/2"**
Copper
Strap

Order:
58R-112S



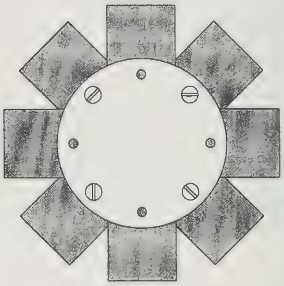
6 to **1** AWG
Cable
to **1-1/2"**
Copper **S**trap

Order:
1C-112S



1/0 AWG
to 6/0 AWG
Cable
to **1-1/2"**
Copper **S**trap

Order:
10C-112S



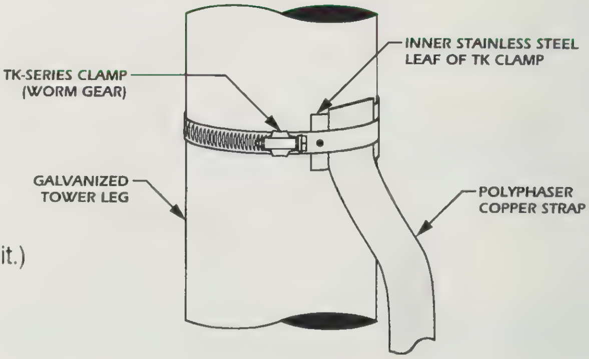
1-1/2" or **3"**
Multi **C**opper **S**trap

Order: **MSC-3**

COPPER TO TOWER LEG CORROSION FREE GROUND CLAMPS

APPLICATION:

To provide a good connection of copper wire or strap to galvanized tower leg, without any corrosion and without the worry of exothermic welding to your tower structure.


TK-SERIES CLAMP (WORM GEAR)
INNER STAINLESS STEEL LEAF OF TK CLAMP
GALVANIZED TOWER LEG
POLYPHASER COPPER STRAP

- <1 milliohm typical contact resistance
- Marine quality 100% 300 stainless
- Clamps copper wire or strap (See page 52 for Copper Cleaning Kit.)
- No dissimilar metal corrosion
- Less expensive than bronze clamps
- 4 models from 5/8" to 5"
- Can be joined together for even larger sizes

Order:	TK-1	5/8" to 1-1/4"	1-1/2" (tapered) strap to ground rod
	TK-2	1-1/4" to 2-1/4"	1-1/2" strap to Rohn 25, 45 and 65 tower legs
	TK-3	2-1/4" to 3-3/4"	1-1/2" strap to water mains
	TK-4	3-1/2" to 5"	3" strap to fire raisers/tower legs

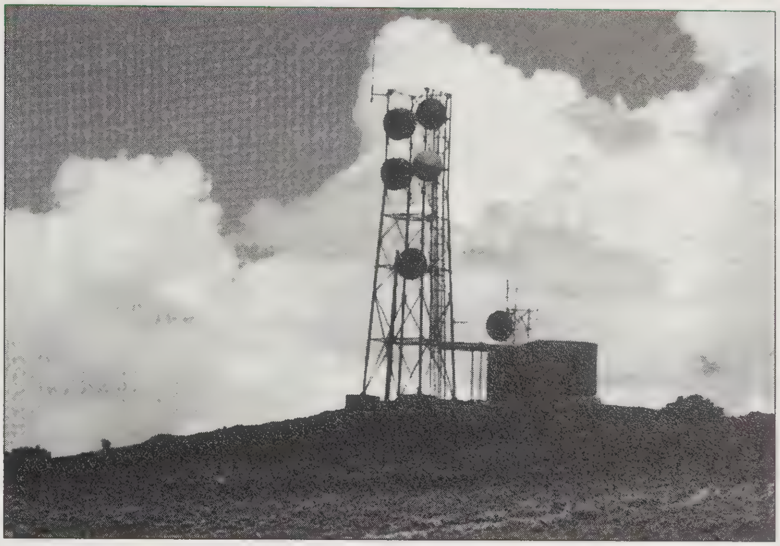
CONSULTING SERVICES

APPLICATION:

Highly qualified engineers provide expertise to assess the effectiveness of your site grounding and lightning protection system.

- **Evaluate plans for new or existing site**
- **Review or write protection standards**
- **Design an optimal package for specific requirements**
- **Create custom products to enhance your systems**
- **Prepare an engineering analysis of your site complete with video and written comments**
- **Work with your engineers, subcontractors and construction firms to assure equipment protection**

Consulting contracts are tailored to your requirements including county, state and local regulations or military specifications. Programs are provided to match your schedule and budget to assure complete equipment protection. Ongoing consultation services continue after project completion.



*Consulting Options**

A. *On-Site Visit Consulting Package:* Engineering site visit includes technical analysis by engineering staff with written follow-up report and recommendations including a documentation video.

B. *Customer Provided Video for Analysis:* A comprehensive checklist is provided to each customer so a site can be videotaped and the tape forwarded to PolyPhaser for engineering analysis.

C. *Testing and Standards Review and Recommendations Package:* Customers may want to include product testing in conjunction with a written review of customer lightning protection standards.

Order: Consult-A
Consult-B
Consult-C

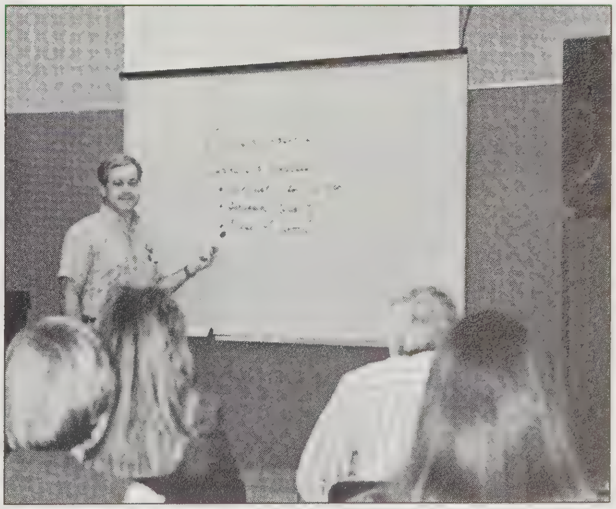
**Options will be quoted separately to accommodate customer requirements.*

TRAINING

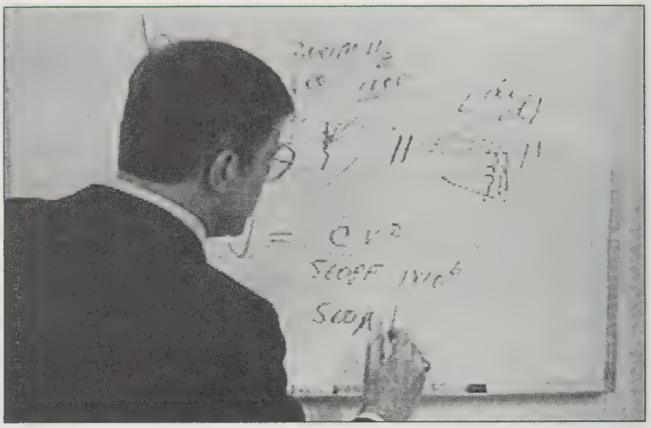
APPLICATION:

At our corporate training center, specialists will guide you from theory to practical application. Learn from our training experts regarding *Fundamentals of Lightning and Grounding; Grounding: Applications, Methods and Solutions;* and *Hands-On Learning Activities.* PolyPhaser can provide the latest information to assist in developing and maintaining the best in lightning protection. Anonymous video clips from worldwide consulting supplement classroom experience. Specialized training or off-site seminars are quoted separately. Call PolyPhaser with your requirements.

Order: **TRAINING** (Limited dates available)



GROUNDING VIDEO TAPES



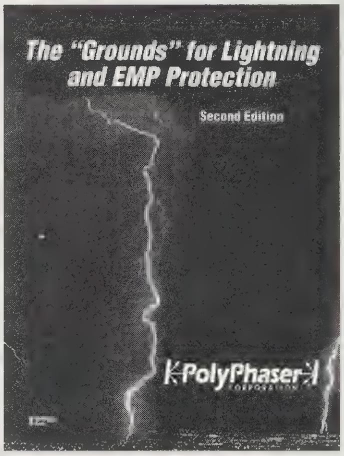
APPLICATION:

Hour long overview of grounding covers types of lightning, why damage occurs, grounding types and materials, measuring, protectors and their placement, and tying it all together.

- One hour w/charts, graphs, pictures and drawings
- Available in VHS: NTSC, PAL, N PAL, M PAL, SECAM, and MESECAM, TV formats

Order: Grounding - An Overview
Note: export orders - please give TV format desired.

THE "GROUNDS" FOR LIGHTNING & EMP PROTECTION, SECOND EDITION

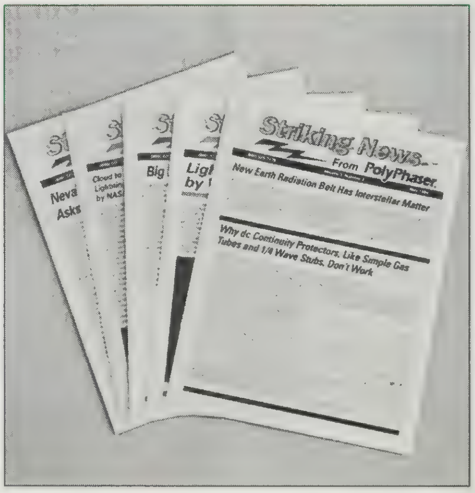


APPLICATION:

This often cited book contains powerful information analyzing proper techniques for grounding and protection against destructive lightning and nuclear electromagnetic pulse (EMP) energy. Drawings help illustrate the concepts in this 100+page comprehensive analysis applicable to all types of communications equipment. Simple math (one formula) with many easy-to-follow explanations of how to and why. Additional topics address telephone, central offices, computers, Local Area Networks, cable TV, television receive only (TVRO), and security cameras.

Order: **GLEP/E** for English version (ISBN 0-9644493-1-5)
GLEP/S for Spanish version (ISBN 0-9644493-2-1)

STRIKING NEWS TUTORIAL NEWSLETTER


Striking News
From PolyPhaser
New Earth Radiation Belt Has Interstellar Matter
Why dc Continuity Protectors, Like Simple Gas Tubes and 1/4 Wave Stubs, Don't Work

APPLICATION:

Communication with customers worldwide is accomplished through our tutorial newsletter, *Striking News*. Details on the latest trends, products, applications, grounding methods, news and information in the industry plus PolyPhaser research and scientific findings are printed here first. Free to all PolyPhaser customers, *Striking News* is mailed worldwide and is regularly published in English.

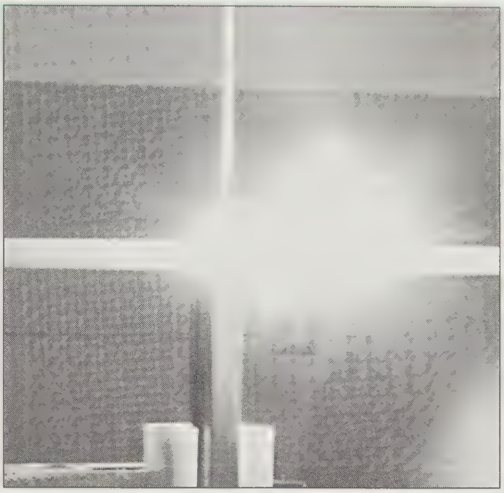
Order: **STRIKING NEWS** for free tutorial newsletter

PRODUCT TESTING CAPABILITIES

APPLICATION:

One of the more difficult tasks facing an O.E.M. is determining what will happen to their product or system when lightning strikes. PolyPhaser has the capability to conduct extensive destructive testing with results measured on the latest 4 giga-sample, 1.1 gigahertz bandwidth digital oscilloscopes.

Customer equipment/system testing is also available on any one of three lightning simulators. Each has its own attributes. Long duration pulses, very high currents to 200,000 amperes and high energy surges are capable. The largest simulator consists of high density capacitors (3/4 ton) which can generate 100kV with 62kA and 100k Joules of energy in a traditional 8/20μs pulse. Customers can witness the tests or tests can be videotaped.



Customer Considerations:

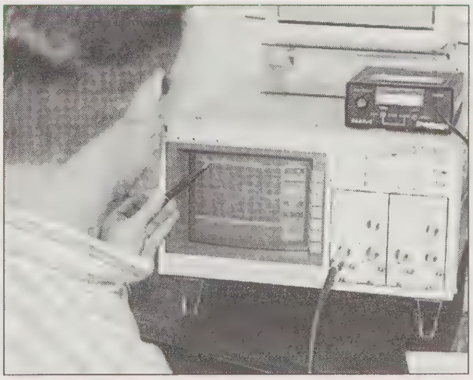
- **Item to be tested, item size and weight, and type of tests and information required.**
- **Specify defined waveforms or standards which may include current peak, duration, open circuit voltage or source resistance, number of hits or related.**
- **Additional tests may include network analyzer measurements of RF, dc, ac and resistance measured at intervals between hits to determine failures.**

Order: TESTING (Call for quote.)

CUSTOM MANUFACTURING

APPLICATION:

New products are developed as a result of customer inquiry and industry needs. Custom protectors are routinely designed, tested and produced as specials. Innovative engineering, state-of-the-art technology, sophisticated testing equipment and experience result in appplication-specific products that meet or exceed your performance requirements. Our Technical Consultants are ready to address your specific needs and applications.



Order: SPECIAL

INTERNET

APPLICATION:

Access PolyPhaser 24 hours a day via the Internet and World Wide Web! Browse our on-line catalog, view back issues of *Striking News,* locate a Distributor or Sales Representative near you, review current employment opportunities, and send electronic mail (E-Mail) to us. Just point your graphical Web browser to: *http://www.polyphaser.com.*

If you don't have access to the World Wide Web, but do have internet electronic mail, you can send questions or comments to: *info@polyphaser.com.*

GROUNDING OVERVIEW

Lightning strikes, like people, come in all different shapes and sizes. It is a statistical event like dice which means that a typical "7" type of lightning can be characterized, but a "2" or "12" can still occur. An economically designed protection/grounding (P/G) system should take into account a typical-to-large strike. One can not put too much money into a P/G system. Money should also be allocated for the maintenance, both routine and preventative, of the P/G system on a monthly or at least yearly basis. This should include testing protectors, measuring your ground system, pulling on ground rods, and cleaning/inspecting connections for corrosion and tightness. It should also involve a re-thinking of the overall system design each time new equipment is installed, moved, or modified.

In a P/G system design one should also think of system noise reduction and EMI/RFI (Tempest) shielding. This can and often is accomplished via a single point grounding system. Sometimes the use of a single ground bus (called the Principal Ground Window or PGW) can act as your single point. All your equipment chassis should be grounded to this bus. Often it can and should be a large surface area connection to the ground system such as via a bulkhead panel system.

Noise reduction can also occur through the use of shielded signal cables that are only grounded on one end. This acts as a Faraday shield. A halo ground system with multiple down conductors to the outside ground system can act as a quasi-Faraday cage and give some low frequency shielding. Properly bonded metal building panels can act as a more effective cage. Double walled screen rooms are the ultimate in shielding. The plasma column of the lightning strike (return stroke) can have a rise time of a microsecond or so, typically. If it hits a tower, the tower will handle the majority of the current to ground. The tower will also radiate the RF energy of the strike. The near field (high magnetic or H field) will be cut by equipment interconnecting wires and induce surge energy. A Faraday cage can reduce this energy as well as adding distance between the tower and the equipment hut.

DISSIPATION BRUSHES

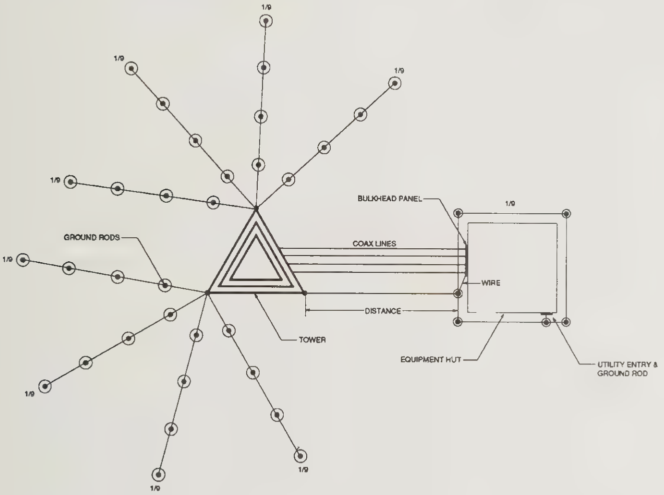
Whether due to a mountain, building or just tower height, the strike frequency goes up as the square of the height over average terrain. Nothing can be done to totally prevent a strike. Making a tower's top more blunt may help so long as no sharp points are present. Whisker brushes and static dissipation gismos will not prevent or even lessen the occurrence of a strike and may even increase its probability. Ions created due to a point or points in the high E fields of a charged cloud will be wind blown and will drift upwards. These ions increase the conductivity of the air and effectively increases the height of the grounded object (tower etc.) thus increasing the frequency of strikes.

The manufacturers of such gismos point out a decrease of electrostatically induced potential in the ground system; this can not happen unless the ground system is almost non-existent (very high resistance). If we were to isolate the entire site from earth, it would have a specific surface area and thus the ability to hold a charge (capacitance). The time to charge the site is the time constant of ground resistance times capacitance. The discharge of the site is the array current divided by the electrostatically induced charge for the site. Typically, the current is about 10 μA for a single point to as much as 0.5 amps for a large system in a 10kV/m E field. An array could represent a 20k ohm load (10kV/.5A = 20kΩ). A 20k ohm ground system (to keep the net gain to zero) would indeed be very poor. Typically, a ground system should be 5 ohms or less which means that the earth can supply the electrostatically induced charge 4,000 times (20k/5 = 4k) faster than what is dissipated by the points.

There is no "isolation" of a ground system as some array gismo sales literature may lead you to believe. By definition, a 5 ohm ground system is 5 ohms to no matter where else on the globe.

A lightning strike starts with a local breakdown of the atmosphere (step leader) and steps about 150 feet in 1 μs time increments every 49μs. During each of the 49μs dormant stages, an imaginary hemisphere of 150' radius can be used to determine the next jumping distance. Any object (such as a tower or even a dissipation gismo) which penetrates this hemisphere, can be chosen as the point of attachment for the return stroke (lightning strike). Since this is a hemisphere, the geometry can be such that a horizontal strike to a tower can occur anywhere above the 150' point over average terrain (so side mounted antennas above this height are just as vulnerable). This has led to the 150' radius rolling ball concept whereby an imaginary ball is rolled along the ground in all directions. Each touch point of the ball with any ground mounted object is subject to an attachment point (hit). From this the need for coax grounding kits at the 150' point and every 100 feet or less above the height, and of course, one at the bottom and one prior to the hut entry should be obvious.

Lightning will take the path of least impedance which is both resistance and inductance. Since every conductor has inductance, it is a matter of surface area (skin effect). The larger the conductive surface, the lower the inductance. Bends add inductance - a coil is the continuous bending of a wire. Ground wires should be large and run straight for minimum inductance and voltage drop. They also should be separated from all other conductors by 6" to 8" and should not be run inside or through a conductor unless it is bonded to it. For conduit, bond at entrance and exit. For metal walls – bond to it on both sides, never go through it.



Your tower will be the point of impact like a pebble going into a still pond. The rings will be equipotential waves as they diffuse into the surrounding soil. The ground wires in the soil still have inductance. This inductance together with the soil resistance sets up a time constant or velocity of propagation (since capacitance is present also). So the ripples will propagate faster with larger surface area wire and better conductive soil. The doping of soil with $MgSO_4$ and $CuSO_4$ salts will help increase soil conductivity and help retain water.

The soil is conductive due to the natural occurring salts and moisture content. It is not prudent to run interconnecting rings around a tower. Self-support towers will pretty much equalize the surge current to each leg (the coax leg may have slightly more current). Guyed towers should not have rings, even if the rings are to act as a collector for the radials. If each radial is interconnected directly to the tower base or leg, the inductance would be less than having only one or two connections going to a ground ring. Rings further out would be connecting radial ground rods that will be at the same potential at the same point in time, thus little current will flow as compared to taking the same material and effort and running another radial from the tower base.

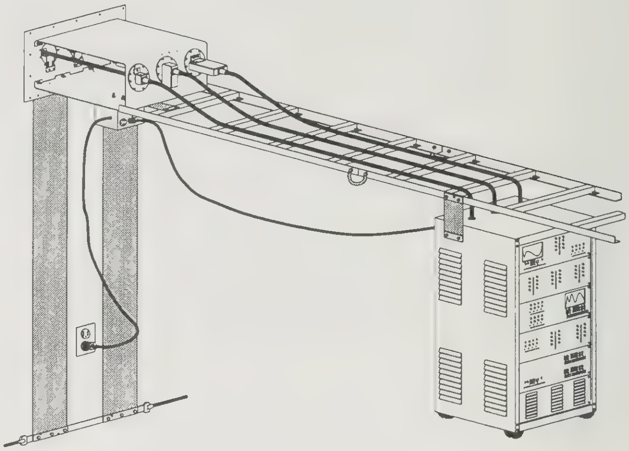
Guy anchors should be grounded with no dissimilar metals (see our book *The 'Grounds' for Lightning and EMP Protection, Second Edition*, Page 24). In poor soil conditions, radials can be used together with ground rods to ground the anchors. A ground system can be obtained in many ways but the most economical is via radials and ground rods. Radials of less than 100 feet will disperse the tower base or guy wire energy outward while the ground rods can help take it to lower, more conductive soil layers. If the surge is not leaked or launched into the soil in the radial section(s), the ground rods, if no better lower soil conductivity is to be had, will develop a high E field at its end and can arc in the soil to spread the charge outward. (This arcing is less likely in higher conductive soils.) It can cause glassification around the rod, starting at the tip and working upward. The hot plasma fuses the silica sand into a glass which is a good insulator since water is boiled out in the process and can no longer re-penetrate the hardened glass. This is why, as a routine maintenance, a tug on the rod can indicate easy movement, a possible indication of glassification.

Unlike the radials, ground rod diameter size will have little effect on impedance unless the rod is very long. It is not always imperative to reach the water table since this may be too far for the rod to be effective. It may be easier to salt dope the rod or to use a chemical ground rod with replaceable salts that collect precipitation. In poor soil conditions, the spacing of ground rods should be closer together since the radial will lose less energy per linear distance. Another way of looking at it is the ground will not shunt the radial's inductance, thus more ground rods will help by either reaching more conductive soil or arcing to relieve the voltage potential. Otherwise the voltage will build up at the tower and attempt to go another, perhaps unwanted, path. The whole practice of lightning protection is to control the discharge path and not have it randomly disperse in any direction. In normally conductive soil, the rods should be spaced the sum of their distance in the soil, apart. No one long deep rod or well casing will be as effective as an array of radials and ground rods even if the one deep rod measures a low resistance; the inductance is usually much greater and thus is a higher impedance path. Even in conductive upper layer soil conditions, soil saturation can occur which can cause eddy currents and additional inductance.

All radials should be run away from the equipment hut. The more radials you have, the more the current is divided. A perimeter ground system (ring) around the hut will help form an equipotential plane. If this ring is approximately equal (in length) to each radial and if eight radials are used, each will have 1/9 the total surge energy leaving only 1/9 the strike energy for the equipment hut perimeter ground. The less the energy to the hut ground, the better. The perimeter should only have one interconnection to the tower base and should be just below the coax cable runs. For mountain tops, where no conductive soil exists and only radials can be used, wide copper strap, 1" to 3" wide, should be used to minimize inductance. For all sites, the re-bar in the concrete should be used to augment your grounding system. Concrete is conductive because of retained moisture and alkalinity. Many people not knowledgeable on how to use the concrete, shy away from it with old tales of "blowing up your concrete." This will not happen. Look at it this way. J bolts or anchor bolts are already embedded into your concrete. If your ground system is not adequate, the current density (J) will be high enough to cause arcing at the bolts. If you were to interconnect the rebar the current density would be reduced and have a less likely chance of arcing to occur. To learn more on designing with the rebar, see our book *The 'Grounds' for Lightning & EMP Protection, Second Edition.*

Ground wires run up a metal tower are a waste of time. The difference in resistance between copper and galvanized steel is lost in the difference in inductance due to surface area (skin effect). Many try to place a lightning rod at the tower top and use the copper cable to run it down to ground. The inductive voltage drop of the wire (>100kV) will cause it to jump (arc) to the tower anyway unless it is stood off about 24" from the tower. In fact the use of bare copper cable can cause a corrosion problem to the tower and should not be used unless covered. Copper should never come in contact with galvanized steel. Likewise tinned copper wire should not be used in the ground together with copper ground rods since the tinning will be leached into the soil in short order.

Try to design some space or distance between the tower and the coax cable entry. This distance will give additional propagational time for the ground to absorb the strike energy. At the building entry bulkhead panel, coax protectors should be used in addition to another set of coax grounding kits. This bulkhead panel should have as large a surface area connecting it to the perimeter ground as the combined surface areas of the coax cables. Tower lighting protectors should also be included and grounded at this same point.



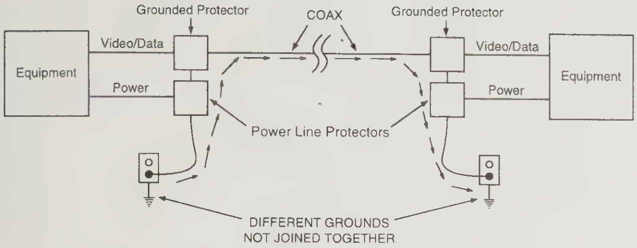
Tower flasher lines, both strobe and conventional, should have protectors to prevent surge entry into the hut on the power lines as well as nuisance damage to strobe PC boards.

To ensure survival of the hut equipment, all Inputs/Outputs (I/Os) must have protection and they should all be ideally located at the principal ground window or bulkhead panel. If these I/Os (power telco, etc.) enter elsewhere, protect them first at the entry point (ground protector to perimeter) run to Perimeter Ground Window (PGW) and protect it again before distribution via the cable trays. (Note: All trays should be grounded to the PGW or bulkhead panel.)

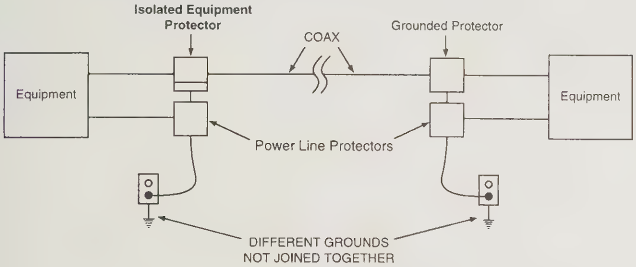
TYPE OF PROTECTORS

The best type of protector is an in-line type because it can better clamp and protect while preventing the sharing of surge voltage and current with your equipment. For telco lines one needs the best protector when just a few lines are used. This is because every ground system will momentarily saturate or elevate with respect to the surrounding area, at least until the surge can propagate and dissipate into the soil. This means that your site ground system will force "on" protectors (power and telco) and dump surge energy onto these outbound lines. Thus the greater the number of lines (telco) you have, the more the surge is divided as it is distributed over these pairs. Vice versa, the single pair needs the world's best protector to ensure equipment survivability from overvoltage stress as larger surge energy is diverted to this single outbound pair.

GROUND LOOP = HUM



GROUND LOOP ELIMINATED by using PolyPhaser's IS-IE series protector, available in 50Ω and 75Ω.


Isolated Equipment Protector
COAX
Grounded Protector
Equipment
Equipment
Power Line Protectors
DIFFERENT GROUNDS NOT JOINED TOGETHER

LOCAL AREA NETWORKS

Where optical fiber is not used, coax or twisted pairs can provide LAN or WAN systems. One major problem often seen is an application between buildings where different local grounds are used. This can cause protectors which protect in differential mode (wire to wire) as well as common mode (wire to ground) to see a voltage over the turn-on threshold between wires and grounds and thus clip, induce a hum, or not allow the system to operate. This is not the fault of the protector but the system design. Grounds should be in common or isolated ground adapter (IGA-90V) used to overcome such design problems.

POWER LINE

Lightning and surge protectors are no substitute for an Uninterruptible Power Supply (UPS). However, many UPS units do not have any or adequate surge protection. In-line protectors can offer filtering of the line; however, don't go overboard on filtering since many protectors use ferrite core material which will saturate on major surges and be useless. Look for only air core type inductors (PolyPhaser uses only air core inductors). They may not offer as low a cut off frequency or as much filter attenuation and are physically larger, but they will not change with surge current or become less effective due to ferrite core magnetic orientation as ferrite core coils will. Noise has never been known to damage equipment circuitry and it takes a lot of noise to couple through to upset a well designed circuit. If your equipment is sensitive and critical, it should be on an UPS which will buffer any line noise from your system since the ac power is re-generated. (Remember filters do not absorb or dissipate energy but merely shunt or reflect it back to its source.)

Power line protectors that cover the wall outlet when they plug in are only good for stand-alone equipment with no other I/Os. This is because other I/Os can input a surge to the equipment and now the power line protector, which is far away on the end of an inductive cord, will be useless in containing the overvoltage and protecting the power supply. Protectors should be in common with (via a short interconnection) the chassis of the equipment that is to be protected and not at the end of a long equipment power cord. This may be hard or impossible to do with consumer type protectors in decorator colored plastic enclosures but not with PolyPhaser's brushed aluminum case. It may not be as pretty as others but lightning protection is no beauty pageant. It isn't a consumer toy but an industrial strength protector.

This is just an overview of proper grounding and protector installation. For a more in-depth look at the why's and wherefore's, our 100+page book *The 'Grounds' for Lightning and EMP Protection* will provide such a view and is available in this catalog.

We have been asked many times after a lightning strike how to determine whether a unit, which has protected your equipment, will work again. A Digi-FIST unit is the best way to test a unit and measure its useful life. However, the end of life mode of almost all units is a "short" mode.

Semiconductors, whether silicon based or Metal Oxide Varistors, (MOV) will die in a shorted mode when at the end of life or when over powered beyond its designed capabilities. However, if subjected to power levels in excess of the fusing levels of the wire leads, the unit may fuse open.

Likewise, gas tubes will die in a shorted mode unless subjected to massive power levels which can explode the gas tube and vent the sub-atmospheric gases, in which case it becomes an open circuit. Lab test levels show that our IS-NEMP, IS-B50 and IS-50 series models will vent the gas tubes at 89kA and above using the IEEE 8/20 waveform. This is 89kA on the center conductor relative to the shield which equates to over 200kA strike levels on the total coax line alone. (See page 4.) If a steel tower structure is present and grounded, further current sharing will take place as described in chapter one of our tutorial book *The 'Grounds' for Lightning & EMP Protection*. This will boost the necessary strike level for gas tube destruction to the very limits that nature can dole out. The cumulative effects of repeated strikes can be measured by our Lightning Strike Counter (LSC) but statistically each strike is somewhat different with different energy levels. The LSC units can only give a rough idea as to the useful life left in any given Impulse Suppressor.

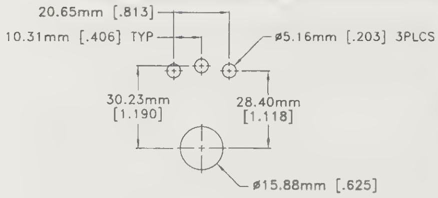
We are working on an "Energy Counter" that can give better results but until then we recommend that an annual spring test with our DIGI-FIST unit will give confidence that your Impulse Suppressors are on the job and ready to protect your equipment. The DIGI-FIST unit comes with an Instruction Book that gives high and low extremes for testing all PolyPhaser models.

Please contact the factory for a Return Authorization Number if you would like us to inspect/test your Impulse Suppressors.

TESTING AND SPECIALS

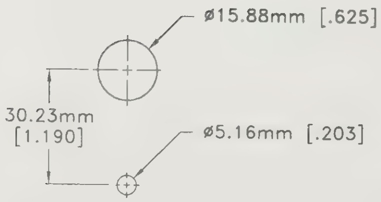
Testing can be done on any product. Please indicate the type of testing that you need. Testing results to Mil specs such as Mil-STD-462 or equal can be obtained in writing only. Some results we may consider proprietary and will not be released without the need to know. Specials done for customers can be sold to others unless we are notified in writing. All other specials will be at our discretion as to saleability to foreign governments.

BULKHEAD MOUNTING HOLES



BULKHEAD MOUNTING HOLES FOR IS-CT/PT FEMALE CONNECTORS

(Not to Scale)



STANDARD BULKHEAD MOUNTING HOLES FOR FEMALE CONNECTORS

(Not to Scale)

Appendix B

MULTI-CHANNEL COMBINING

Combining is summing multiple channels together to feed onto a common cable. Low frequencies and higher frequencies will in time reach a peak voltage together of the same polarity. This voltage summation peak can have more peak power than the sum of their RMS powers. Since the protectors are voltage sensitive, they must be designed to handle combiner outputs or turn-on RF voltage peaks can result. This can cause major problems at other frequencies (intermod, spurs, interference, etc.). Each protector designed for combiners is listed as to its total voltage peak (V_T) that it can handle without RF turn-on. This total is the summation of all the voltage peaks for each channel being combined.

$$V_T = V_{P1} + V_{P2} + V_{P3} \ldots + V_{Pn}$$

where $V_P = 1.414 \cdot X \cdot \sqrt{P_{ch} \cdot 50}$

P_{ch} = channel power out of combiner

and for a

VSWR	X =
1.1 to 1	1.05
1.2 to 1	1.09
1.3 to 1	1.13
1.4 to 1	1.17
1.5 to 1	1.2
1.86 to 1	1.3

Appendix C

TO CALCULATE THE INDUCTANCE OF A WIRE USE:

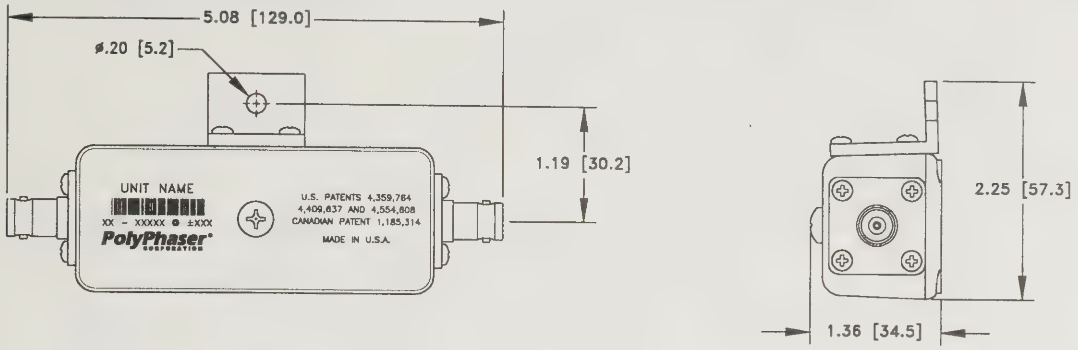
$$L(\text{in } \mu H) = 0.508l\,[2.303 \log_{10} (4\, l/d) - 0.75] \times 10^{-2}$$

TO CALCULATE THE INDUCTANCE OF STRAP USE:

$$L(\text{in } \mu H) = 0.508l\,[2.303 \log_{10} (2\, l/(w + t)) + 0.5 + 0.2235\,(w + t)/l] \times 10^{-2}$$

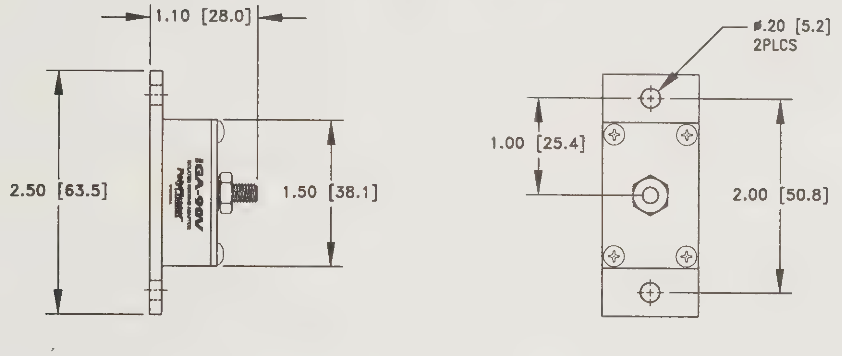
Where
l = length in inches
d = diameter in inches
w = width in inches
t = thickness in inches

EXAMPLE: IS-50BB±6



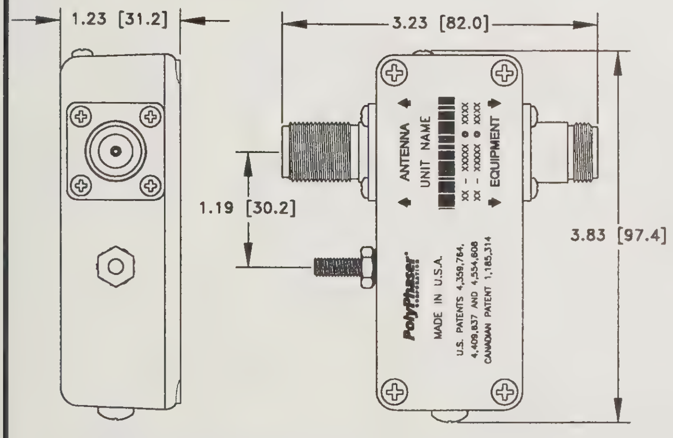
Part 1: dc type (pg. 6)
Shown with female 'BNC' connectors

EXAMPLE: IGA-90V



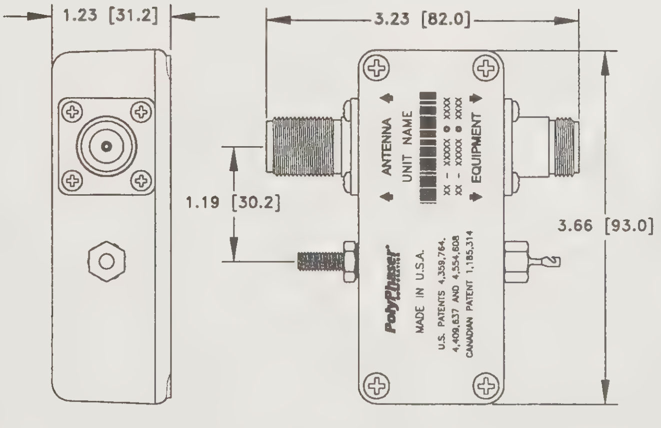
Part 1: isolated ground adapter (pg. 6)
Used with dc protectors above

EXAMPLE: IS-MR50LN



Part 2: dc blocked (pg. 16 & 17)
Part 3: dc blocked & grounded/filtered (pg. 18)
Part 4: dc injector/dc path (pg. 19 to 22)
Part 5: combiner protectors (pg. 24)
Shown with female 'N' connectors

EXAMPLE: IS-DC50LN

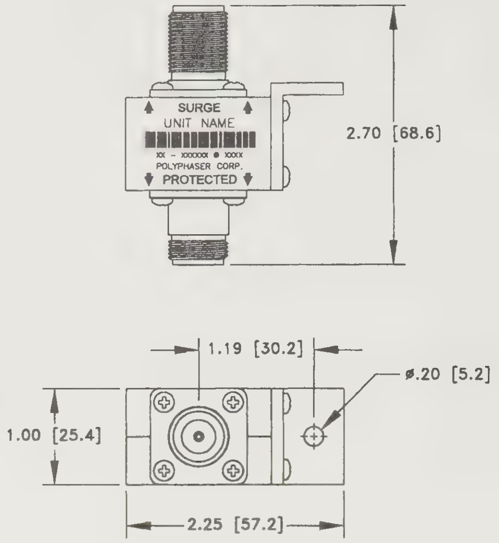


Part 4: dc injector/dc path (pg. 20 & 21)
Shown with female 'N' connectors

All dimensions shown are for reference only.

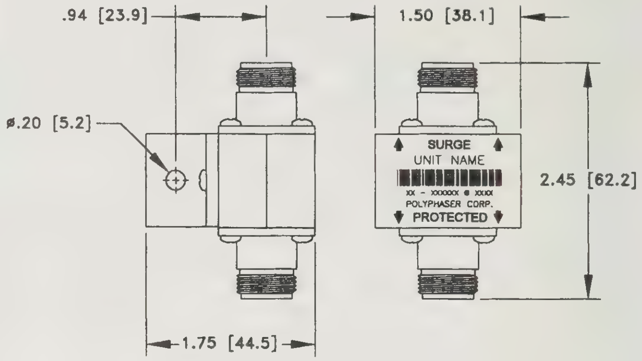
TYPICAL PRODUCT CONFIGURATIONS

EXAMPLE: IS-B50LN-C2



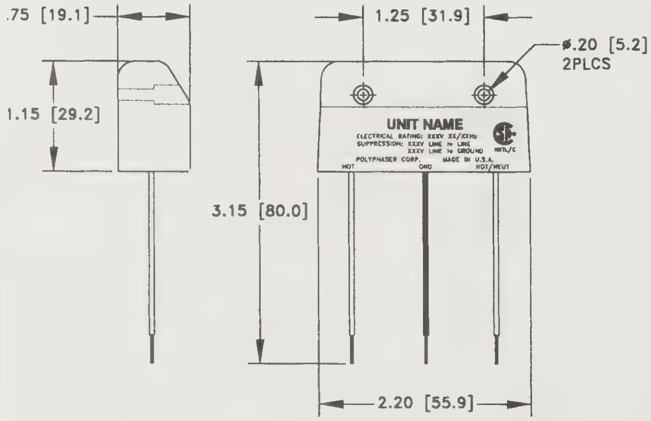
Part 2: dc blocked (pg. 11, 14 & 15)
Shown with female 'N' connectors

EXAMPLE: IS-50NX-C1



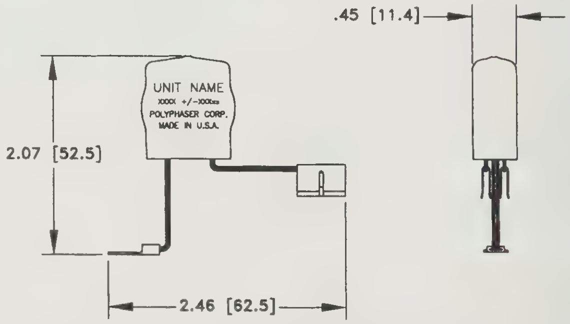
Part 2: dc blocked (pg. 12 & 13)
Shown with female 'N' connectors

EXAMPLE: IS-PSP-240



Part 11: component protectors (pg. 43)

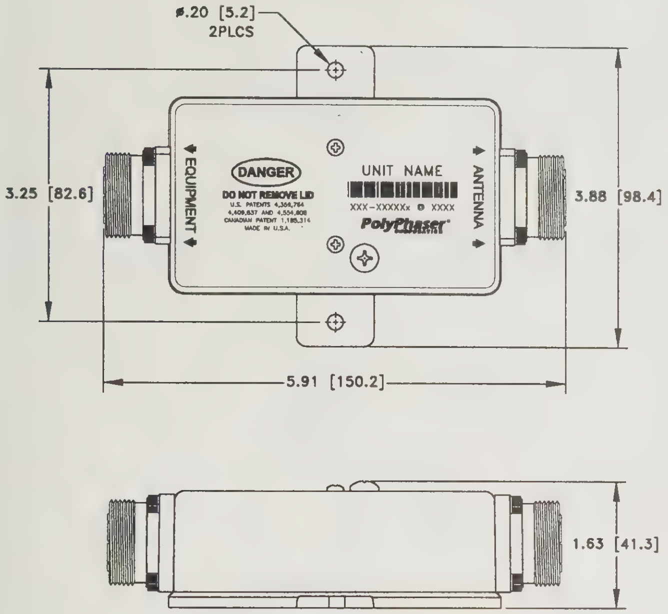
EXAMPLE: IS-MPT-17



Part 8: twisted pair/cable protectors (pg. 34)

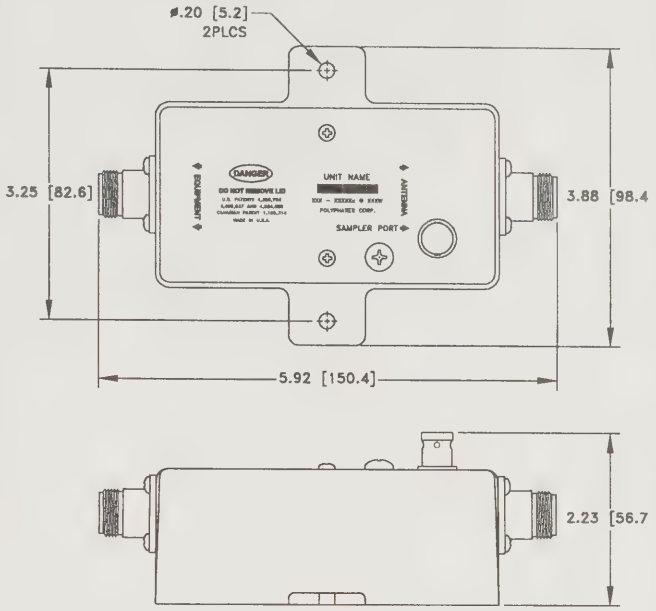
All dimensions shown are for reference only.

EXAMPLE: IS-CT50HD



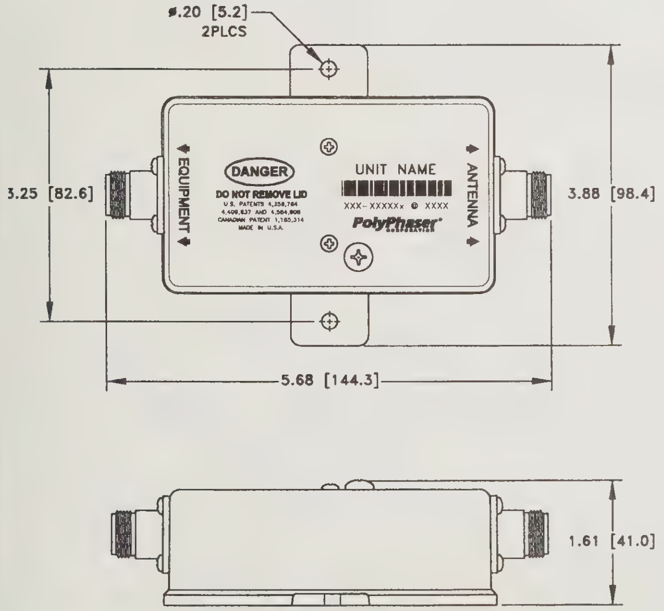
Part 5: combiner protectors (pg. 28)
Shown with female 'DIN' connectors

EXAMPLE: IS-CS50HN



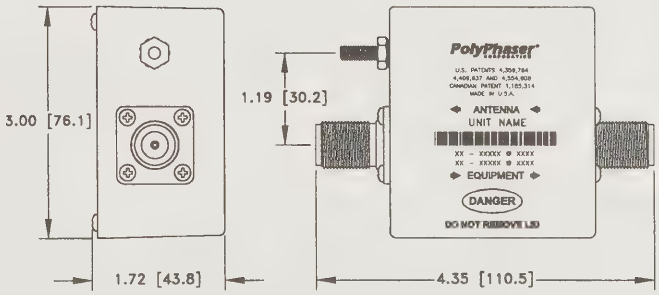
Part 5: combiner protectors (pg. 26 & 27)
Shown with female 'N' connectors

EXAMPLE: IS-CT50HN



Part 5: combiner protectors (pg. 28)
Shown with female 'N' connectors

EXAMPLE: IS-IE50LN-C2

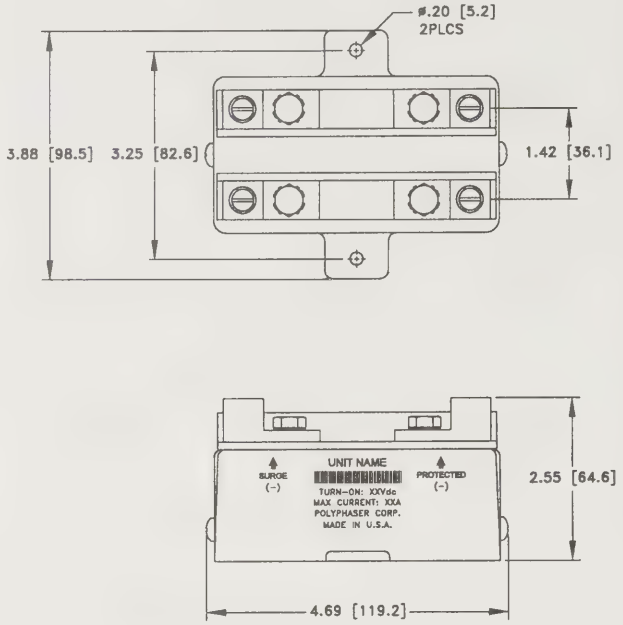


Part 7: rf coupled shield/dc blocked (pg. 30 & 31)
Shown with female 'N' connectors

All dimensions shown are for reference only.

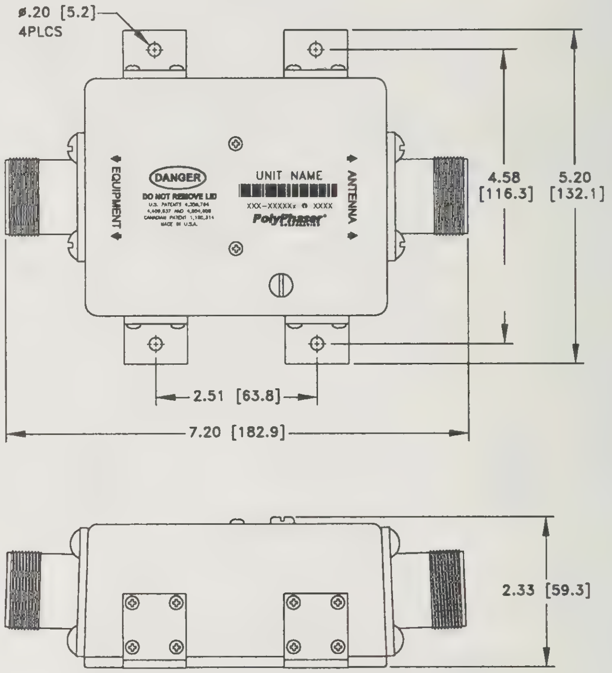
TYPICAL PRODUCT CONFIGURATIONS

EXAMPLE: IS-24VDC-30A-FG



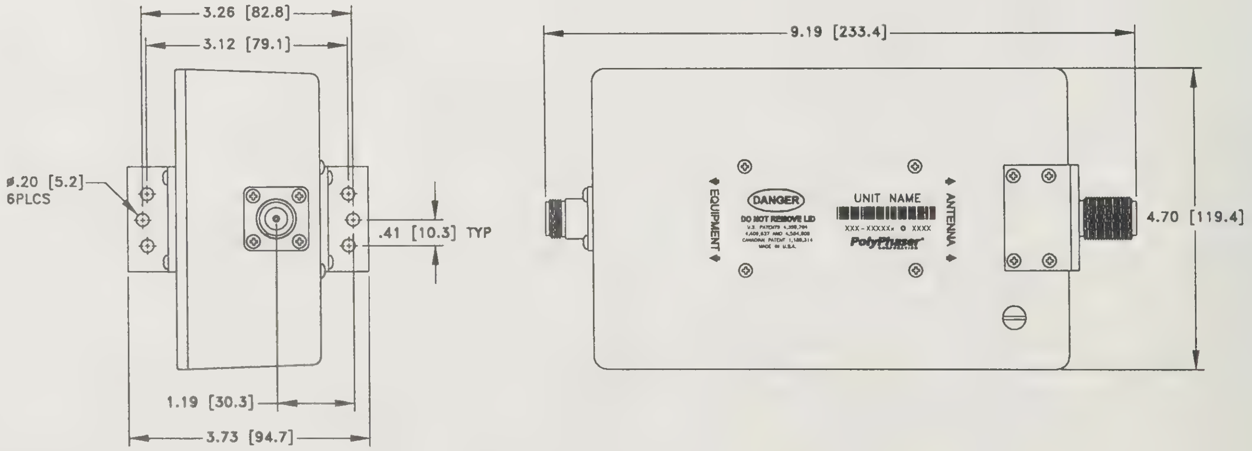
Part 9: dc power protectors (pg. 36)

EXAMPLE: IS-CT50HLC



Part 5: combiner protectors (pg. 28)
Shown with female 'LC' connectors

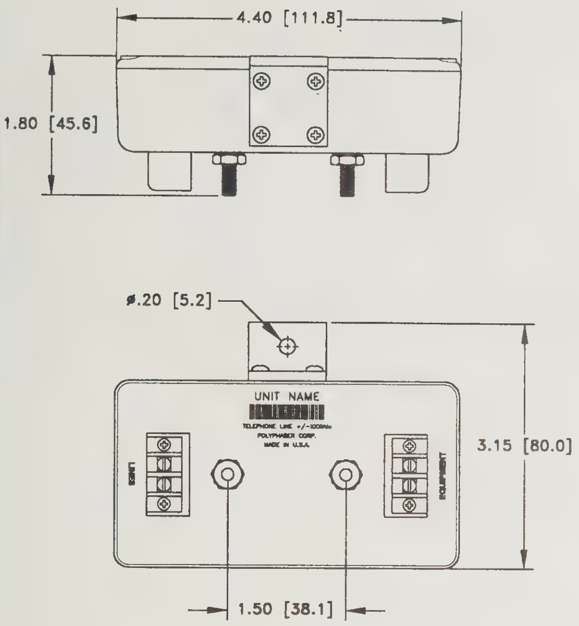
EXAMPLE: IS-UT50HN-B



Part 5: combiner protectors (pg. 25)
Shown with female 'N' connectors

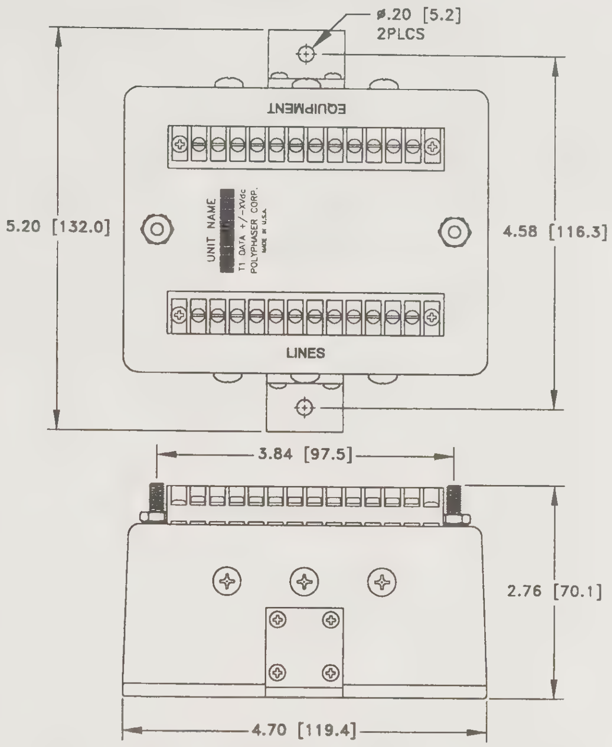
All dimensions shown are for reference only.

EXAMPLE: IS-SPTL



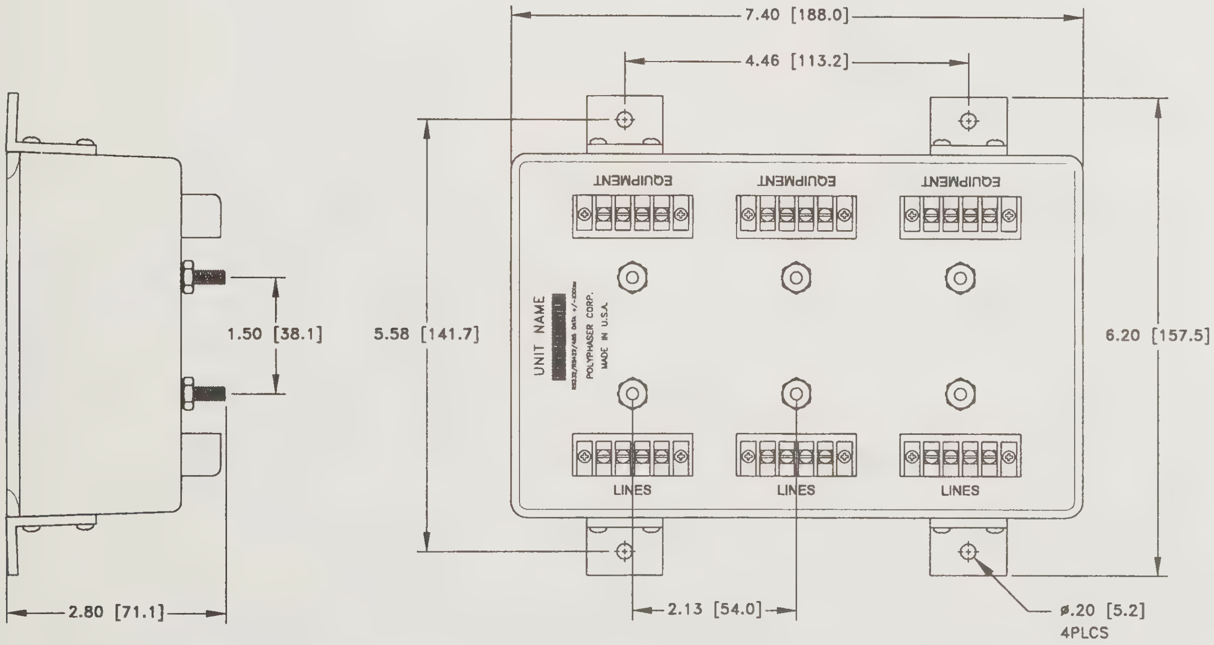
Part 8: twisted pair/cable protectors (pg. 32 & 33)

EXAMPLE: IS-3T1



Part 8: twisted pair/cable protectors (pg. 32 & 33)

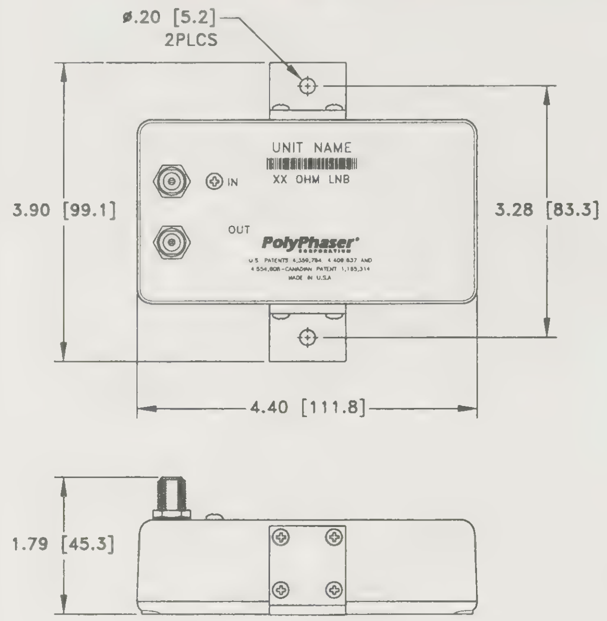
EXAMPLE: IS-6PDDL



Part 8: twisted pair/cable protectors (pg. 32 & 33)

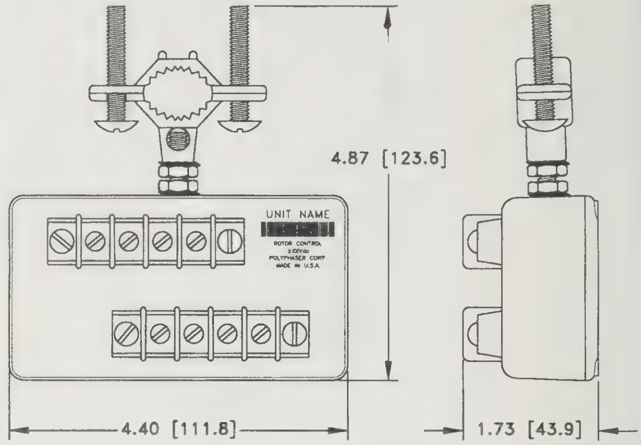
All dimensions shown are for reference only.

EXAMPLE: IS-SB75F



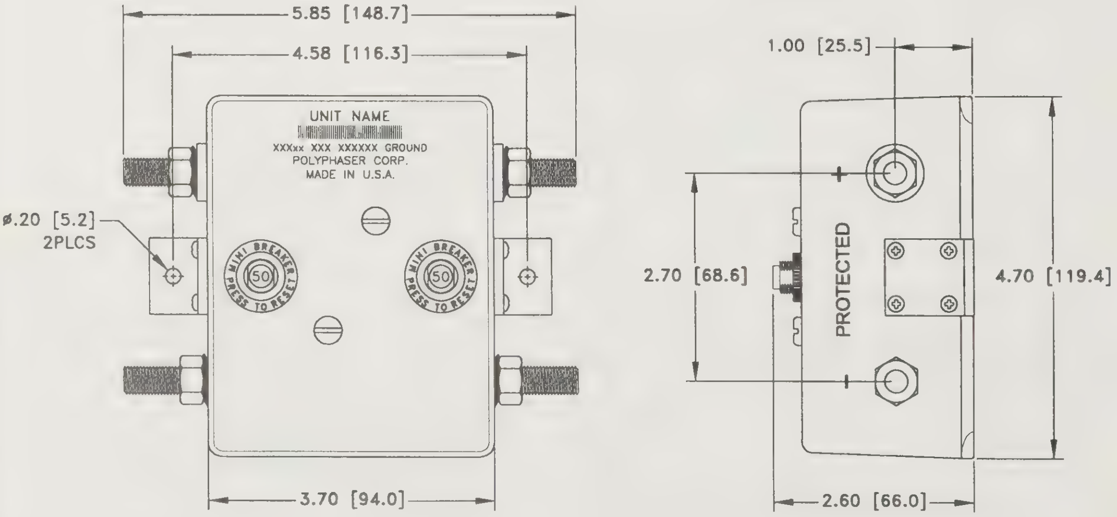
Part 4: dc injector/dc path (pg. 23)
Shown with female 'F' connectors

EXAMPLE: IS-RCT-J1



Part 8: twisted pair/cable protectors (pg. 35)

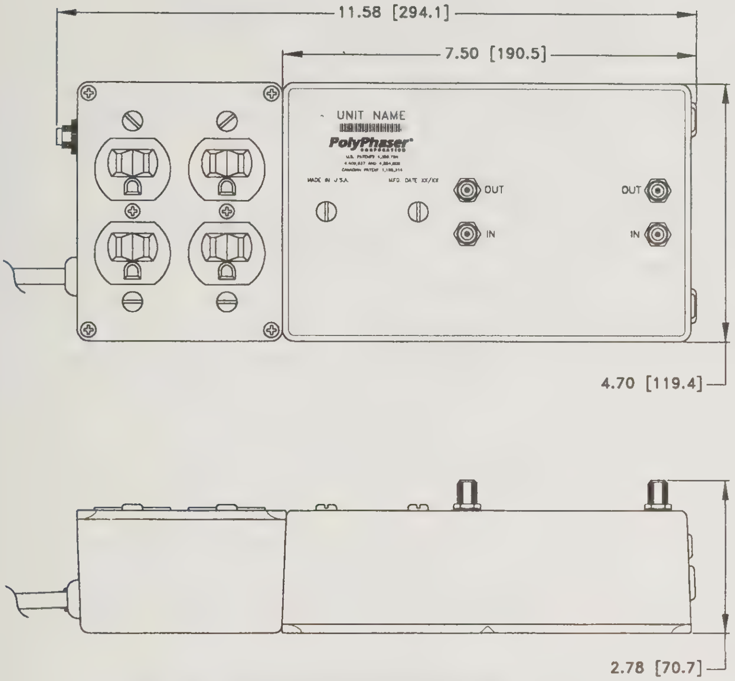
EXAMPLE: IS-48VDC-50A-NG



Part 9: dc power protectors (pg. 36)

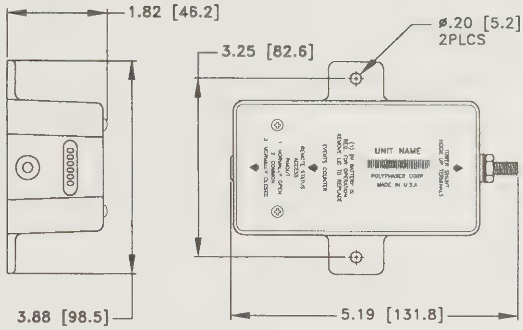
All dimensions shown are for reference only.

EXAMPLE: IS-PLTVRO-2P



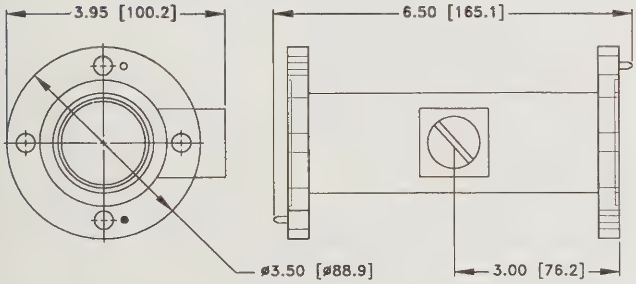
Part 6: special application/satellite dish (pg. 29)
Shown with female 'F' connectors

EXAMPLE: LSC-13



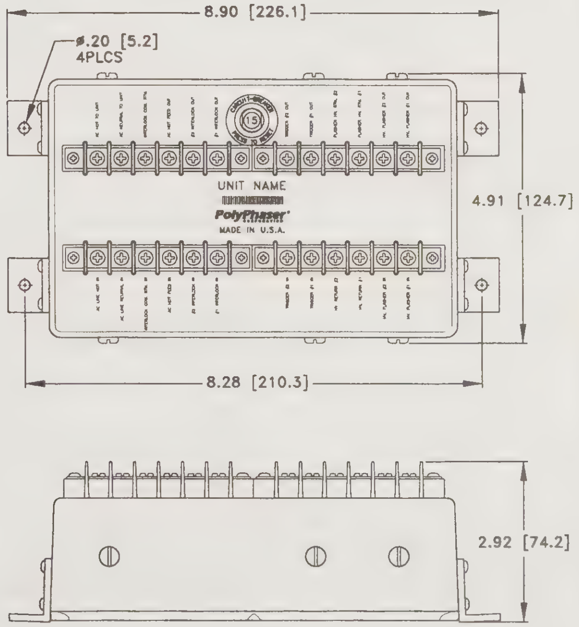
Part 12: test equipment (pg. 46)

EXAMPLE: IS-158E



Part 1: high powered series (pg. 8)
Shown with 'EIA' connectors

EXAMPLE: IS-12WFU



Part 11: component protectors (pg. 44)

All dimensions shown are for reference only.

DEFINITION OF TERMS

BI-PHASE
Found as a power feed to most U.S. homes. Derived from a center tapped transformer, it contains two hot phases (180°) and the center tapped is the neutral return which is earth-grounded.

CAPACITANCE
Measured at 1.0kHz unless otherwise stated.

CLAMP
To clip. To hold turn-on voltage as current is increased. Turn-on voltage is the same or nearly the same as "on" voltage drop.

CLAMPING RATIO
The ratio of voltage drop at a given current to the turn-on voltage.

CLAMPING SPEED
Measured with full lead length using a 1kV/ns waveform in a 50Ω system, with ≥300MHz or larger bandwidth.

COMBINER
The summation of signals into one transmission line. The peak voltage from each signal will be added together but they will be higher than just the sum of the power would indicate.

COMMON MODE
With reference to ground.

COULOMB
Measurement of charge. Often used to indicate the amount of transferred charge through a gas tube to determine gas tube life. "Q" abbreviation. Current times time.

CROWBAR
To turn-on and clamp close to ground level. Having a high turn-on trigger voltage and a low "on" voltage drop.

DIFFERENTIAL MODE
Referenced only between conductors (not referenced to ground).

DIPLEXER
(TV Broadcasting). The combining of two transmitters into one transmission line. TV visual and aural.

DUPLEXER
Simultaneous receive and transmit on one transmission line. Where a T connector splits/combines the signals to two groups of filters. The receiver filter passes the receive frequency while rejecting (band stop) the transmitter's frequency. The transmitter filter passes its frequency while attenuating the Class C transmit noise at the receive frequency.

EMI/RFI
Electro Magnetic Interference/Radio Frequency Interference. Broad spectrum noise or interfering signals.

EMP
Electro Magnetic Pulse, usually referred to as the man-made generation by detonation of a nuclear bomb at a high altitude, which generates a very fast pulse (RF) which can be captured by antennas and long unshielded lines. Sometimes referred to as NEMP, HEMP, etc. Lightning can also generate an EMP near the event. Referred to as LEMP.

EMP RATED
Rated as having a fast enough turn-on time or filtering to protect against the effects of an EMP event.

FARADAY SHIELD
An electrostatic (E field) shield made up of a conductive or partially conductive material or grid. A Faraday cage or screen room is effective for protecting inside equipment from outside radiated RF energies.

FILTERING (EMI/RFI)
Measured in a 50Ω system - loaded. As per MIL-STD-220.

FREQ. RANGE
The bandwidth over which both the listed maximum VSWR and Insertion Loss specifications are valid.

GROUND IMPEDANCE
The ground resistance and the inductance/capacitance value of the grounding system. Also called dynamic surge ground impedance, and must be measured by using a dynamic ground tester.

GROUND RESISTANCE
The resistance value of a given ground rod or grounding system as measured, usually by a fall of potential (3 stake) method.

HF
High Frequency — normally from 3 to 30MHz, however in this catalog it covers from 1.5 to 30MHz.

HOUSED USE ONLY
For indoor use, or must be further enclosed or rain-proofed for outdoor usage.

IMPEDANCE
Nominal impedance of the device. The variation of this impedance with frequency is measured as VSWR.

IN-LINE
Power or signal passage through unit. In series with line. Usually a multi-stage protector. Best protection method.

INSERTION LOSS
The worst case loss of the device across the stated frequency range. The loss due to the insertion of the unit in series with a signal path.

JOULES
A unit of energy. One Joule for one second is equal to one watt of power. Current times time times voltage.

LEAKAGE CURRENT

Usually measured at 50 or 60Hz with 120, 240 or 480 volts ac. However, it can be ac or dc at a specific voltage and frequency.

LOOP RESISTANCE

Total resistance as measured across the input with the output shorted.

MAX PEAK LET-THROUGH VOLTAGE

Measured at a given surge current using a given waveform, and using ≥300MHz bandwidth across a 50Ω impedance. (Note: this 50Ω impedance may be dc blocked [large bandwidth compared to the surge frequencies present] and 50Ω resistive load [termination]).

MAX. POWER

Continuous transmit power (CW).

MAX. SURGE

The maximum single surge current and specified waveform that can be handled by the device without failure during the conduction of that waveform and which ends the life of the device for conducting successive waveforms, but does not allow any generation of outward projectiles.

MULTI-STRIKE CAPABILITY

In most applications current sharing will occur, and in a direct strike event the unit will survive to work again.

RAINPROOF

The act of weather sealing to protect from moisture.

RECEIVER MULTICOUPLER

Sometimes with an amplifier this device has one antenna line and multiple outlets.

RF

Radio Frequencies - any and all frequencies that can be radiated as an electromagnetic wave (plane wave).

SAFETY GROUND

The local earth ground. The earth ground which grounds the neutral return. It may be green or bare and can be via a metal conduit. It may be earth grounded as many times as needed. (Neutral must only be grounded once at the entry location).

SHF

Super High Frequency — from 3000MHz to 30GHz.

SHUNT

Line-to-ground. No power or signal passage through unit. Not in-series with line.

SINGLE PHASE

A true single phase supply. Usually a two-wire system with one hot phase and a neutral return. A safety earth ground is also present.

SKIN EFFECT

The gradient conduction and propagation of RF or RF components of a surge on the outer surfaces of conductors.

TEMPERATURE

The extremes of operating or storage that the unit or unit parts have been tested to under MIL-STD-202 for thermal shock.

THREE PHASE

Invented by Nikola Tesla which beat Edison's distribution system. It consists of poly-phases 120° apart on at least three wires (Delta) and often four wires (Wye). The fourth wire is a grounded neutral return. In a Delta system there is no reference to ground and thus it is more susceptible to lightning problems.

THROUGHPUT ENERGY

The total energy that will be let through the device using the indicated surge waveform.

TOTAL SURGE ENERGY

Total sum of surge energy for all lines of a protector unit. Measured in Joules. The minimum total energy which results in the failure of the unit.

TRANSFER IMPEDANCE

Referring to coax, is the impedance to transfer into or outside the coax at various frequencies usually below 1MHz. Due to loss of skin effect attenuation or shielding at these low frequencies, coax can be susceptible to interference and noise as well as the radiation of such signals.

TURN-ON TIME — GAS TUBE

The time between when the ramp voltage just exceeds the dc turn-on voltage of the device and the point at which 50% of the peak voltage is achieved during the turn-on (crowbar) process. Measured in a 50Ω system with ≥300MHz bandwidth.

TURN-ON Vac

The maximum ac sine wave voltage that can be passed with the peaks just at the turn-on Vdc level.

TURN-ON Vdc

Turn-on voltage at 1mA dc with a ramp of 100v/ms typical.

UHF

Ultra-High Frequency — normally from 300 to 3000MHz however in this catalog we breakout the 800 to 1000MHz separately even though it is within this category.

VHF

Very High Frequency — from 30 to 300MHz.

VSWR

Worst case Voltage Standing Wave Ratio (VSWR) of the device across the stated frequency range. VSWR is the amount of reflected signal due to an impedance mismatch.

V_T MAX

The max peak voltage of all combined waveforms. V_{TOTAL} is used for multi-coupled or combined transmit signals.

STANDARD TERMS AND CONDITIONS

1. ORDERING GOODS. All orders for goods must be made or confirmed in writing. PolyPhaser's acceptance of any order shall occur only after receipt of Purchaser's written order or confirmation *and* delivery of PolyPhaser's written confirmation to Purchaser.

2. PRICES. Unless otherwise quoted in a firm offer, all prices shall be as described in PolyPhaser's price list last published before PolyPhaser's receipt of Purchaser's written order or confirmation. PolyPhaser shall provide firm quotes only in writing. Unless otherwise specified, all firm quotes shall expire thirty (30) days from date of issuance. Prices are subject to change at any time without notice. Prices do not include federal, state or local taxes, freight or insurance.

3. TERMS. Domestic sales on account are net thirty (30) days upon previously approved credit only. All other sales shall be Cash, Discover, MasterCard, Visa, Prepaid (before shipping) or COD. International sales shall be prepaid or payment guaranteed by Irrevocable Letter of Credit, all bank charges paid by Purchaser. Purchaser may purchase goods on account or credit only after approval by PolyPhaser's Credit Department.

4. DELIVERY AND SHIPPING. Unless otherwise requested in writing before shipment:

(1) All domestic orders shall be shipped (a) prepaid, insured FOB destination, UPS Ground Service; or (b) COD or on account, FOB PolyPhaser's factory, Minden, Nevada; and

(2) All international orders shall be shipped insured air delivery freight collect via carriers serving Reno/Tahoe International Airport. All freight and insurance charges shall be payable by Purchaser (in addition to the purchase price for the goods) in accordance with Section 3 TERMS above. Except goods shipped FOB destination, Purchaser bears the risk of all loss or damage to goods in transit, and must make any claim for damage or loss during shipment directly with the carrier. Identification of goods shall occur when PolyPhaser places the goods in the custody of carrier for shipment.

5. INSPECTION AND ACCEPTANCE. All claims for damages, errors, shortages or non-conformance of goods must be made to PolyPhaser in writing within thirty (30) days of Purchaser's receipt of the goods. Purchaser's failure to make such claim within the time permitted shall constitute Purchaser's irrevocable acceptance of the goods.

6. MODIFICATIONS. PolyPhaser reserves the right to modify and change specifications with respect to any goods without notice, and to substitute such modified goods to the extent that they meet or exceed the performance specifications of the goods ordered by Purchaser.

7. RETURNS AND ALLOWANCES. Goods rejected by Purchaser for damage (other than during shipping) or non-conformance must be returned to PolyPhaser within thirty (30) days of Purchaser's timely rejection thereof. All other returns, whether for warranty or otherwise, may be returned only after written notice given by Purchaser to PolyPhaser and written authorization and acceptance by PolyPhaser. Purchaser shall ship all returned goods insured freight collect by carrier designated by PolyPhaser. Credit or adjustment for returned goods shall be subject to inspection and acceptance by PolyPhaser at PolyPhaser's factory, Minden, Nevada. Non-standard catalog items and items specially manufactured for Purchaser are non-cancelable, non-returnable, non-refundable except as to warranty defects and non-conformance to manufacturing specifications.

8. LIMITED WARRANTY. POLYPHASER WARRANTS THAT AT THE TIME OF SHIPMENT THE GOODS SHALL MEET OR EXCEED ALL OF POLYPHASER'S PUBLISHED SPECIFICATIONS FOR SUCH GOODS AND SHALL BE AND REMAIN FREE OF DEFECTS IN WORKMANSHIP AND MATERIALS FOR A PERIOD ENDING TEN (10) YEARS AFTER THE DATE OF SHIPMENT OF THE GOODS TO PURCHASER. PURCHASER AGREES THAT THE GOODS ARE DESIGNED ACCORDING TO SPECIFICATIONS SUITABLE FOR PURCHASER'S PURPOSES, AND THAT, EXCEPT AS SET FORTH IN THIS LIMITED WARRANTY, POLYPHASER DISCLAIMS ANY WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY AS TO THE DESIGN, FITNESS, CONDITION, MERCHANTABILITY OR DESCRIPTION OF OR AS TO THE QUALITY OF THE MATERIAL OR WORKMANSHIP IN THE GOODS, OR AS TO THEIR FITNESS FOR ANY PARTICULAR PURPOSE FOR ANY TRADE OR BUSINESS, OR ANY OTHER REPRESENTATION OR WARRANTY WHATSOEVER. Also excluded from this limited warranty are goods covered by other written manufacturer or supplier warranties, damage resulting from ordinary wear and tear, abusive use or lack of proper maintenance, work not done by PolyPhaser or PolyPhaser's contractor or agents, or loss or injury caused by the elements or during shipment to or from Purchaser. Purchaser agrees to notify PolyPhaser in writing within thirty (30) days of Purchaser's discovery of any problem with any goods subject to this limited warranty. Goods determined to be defective in materials or workmanship within the time described in this Limited Warranty shall be repaired, replaced, or price fully refunded at PolyPhaser's sole discretion, and only after Purchaser's full compliance with the terms of RETURNS AND ALLOWANCES above, PolyPhaser's written approval for return, and examination by PolyPhaser at PolyPhaser's factory. PolyPhaser shall notify Purchaser of its decision to repair, replace, refund the purchase price, or to deny liability under this Limited Warranty within sixty (60) days of PolyPhaser's receipt of the returned goods. The warranties contained in this Limited Warranty are personal to Purchaser and are not assignable by Purchaser to any transferee of the goods.

9. LIMITATION OF LIABILITY. PolyPhaser shall not under any circumstances (a) be liable to Purchaser for any warranty claim relating to the goods or components that Purchaser asserts more than ten (10) years after the date of shipment of the goods to Purchaser; (b) be liable to Purchaser for any damages in excess of the amount actually paid by Purchaser to PolyPhaser for the goods as to which Purchaser makes a warranty claim or the cost of repair or replacement, whichever is the smaller amount; (3) be liable to Purchaser for any loss of use or profits or other special or consequential damages; or (4) be responsible for any personal injury, or property damage alleged to arise as a result of Purchaser's or any third party's use of the goods. Purchaser expressly assumes the risk of and the responsibility for any and all damages for personal injury, property damage, loss of use or profits or other special or consequential damages relating in any way to the goods or use thereof. The above limitation shall apply even though it may be alleged that PolyPhaser or its agents have been actively or passively negligent.

10. VENUE AND JURISDICTION. The sole and exclusive forum for the resolution of any disputes arising between Purchaser and PolyPhaser shall be the Ninth Judicial District Court in the State of Nevada, in and for Douglas County, or, upon proper legal basis, the United States District Court for the District of Nevada, Northern Nevada Division, and Purchaser and PolyPhaser each confers jurisdiction over the resolution of such disputes upon these courts.

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STANDARD CONNECTORS

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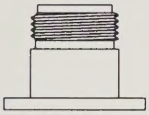
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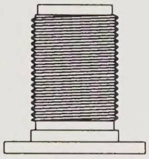
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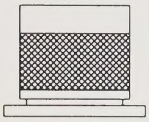
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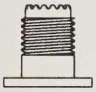
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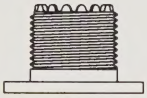
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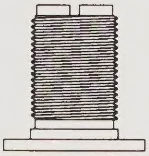
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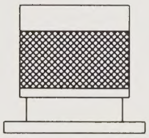
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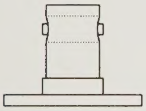
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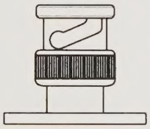
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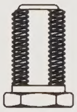
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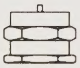
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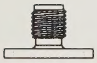
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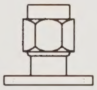
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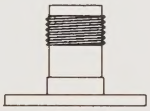
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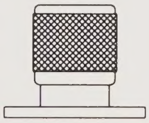
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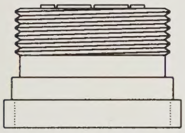
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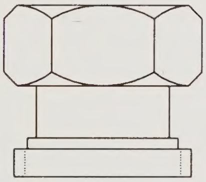
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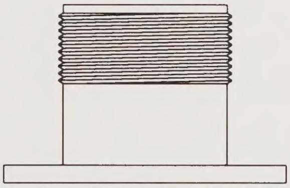
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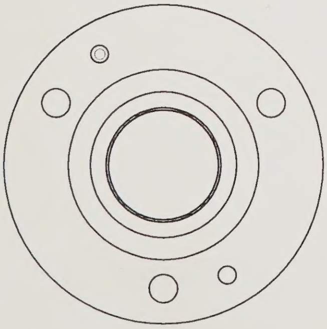
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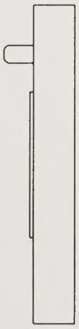
SIDE VIEW

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